

Hierarchical Exploratory Factor Analyses of the Woodcock-Johnson IV Full Test Battery: Implications for CHC Application in School Psychology

Stefan C. Dombrowski
Rider University

Ryan J. McGill
The College of William & Mary

Gary L. Canivez
Eastern Illinois University

The Woodcock-Johnson (fourth edition; WJ IV; Schrank, McGrew, & Mather, 2014a) was recently redeveloped and retains its linkage to Cattell-Horn-Carroll theory (CHC). Independent reviews (e.g., Canivez, 2017) and investigations (Dombrowski, McGill, & Canivez, 2017) of the structure of the WJ IV full test battery and WJ IV Cognitive have suggested the need for additional factor analytic exploration. Accordingly, the present study used principal axis factoring (PAF) followed by the Schmid and Leiman (SL; Schmid & Leiman, 1957) procedure with the 2 school-aged correlation matrices from the normative sample to determine the degree to which the WJ IV total battery structure could be replicated. Although 7 factors emerged across the 9 to 19 age range, the pattern of subtests loadings did not fully cohere with the structure presented in the *Technical Manual*, most notably for the academic fluency subtests. Also, the Fluid Reasoning (Gf) and Quantitative Reasoning (Gq) subtests coalesced to form a combined factor rather than 2 separate factors and the Long Term Retrieval (Gltr) subtests aligned with a variety of different factors. The results of this study indicated that the general intelligence factor variance far exceeded the variance attributed to the lower-order CHC factors. The combination of subtest migration and nominal total/common variance of the CHC lower-order factors suggests caution when interpreting the myriad CHC-related indices when making high stakes decisions. Implications for clinical practice are discussed.

Impact and Implications

Results indicate that the WJ IV total battery may not measure some hypothesized CHC dimensions well and that the subtest composition of the CHC factors is different from what is indicated in the *Technical Manual*. Specifically, results did not locate distinct Gf, Gv, and Gltr factors and the composition of the Gs, Gwm, and Gc factors is different than what is presented in the *Technical Manual*. As a result, users of the WJ IV are encouraged to interpret the WJ IV CHC-based indices carefully when using the WJ IV full battery of tests in clinical practice.

Keywords: exploratory factor analysis, higher order factor analysis, Cattell-Horn-Carroll theory, Schmid-Leiman orthogonalization, general intelligence

Supplemental materials: <http://dx.doi.org/10.1037/spq0000221.supp>

School psychologists devote a considerable portion of time administering and interpreting individually administered tests of intelligence and other related psychoeducational abilities (Dombrowski, 2015a; Sotelo-Dynega & Dixon, 2014). The Woodcock-Johnson battery of

tests are likely among the more commonly used instruments to evaluate cognitive abilities and academic achievement (Schrank, Decker, & Garruto, 2016). The WJ-IV was recently revised and comprises separate tests of cognitive ability, achievement, and oral language (Schrank, Mather, & McGrew, 2014a, 2014b; Schrank, McGrew, & Mather, 2014a, 2014b). Guided by Carroll's (1993) three-stratum theory of cognitive abilities, the work of Horn and Cattell (1966), and contemporary neuroscience research on memory (e.g., McGrew, LaForte, & Schrank, 2014) the WJ IV was designed to measure several CHC factors including Comprehension-Knowledge (Gc), Fluid Reasoning (Gf), Short-Term Working Memory (Gwm), Cognitive Processing Speed (Gs), Auditory Processing (Ga), Long Term Retrieval (Gltr), Visual-Processing (Gv), Reading-Writing (Grw) and Quantitative-Numeric (Gq; McGrew et al., 2014).

When analyzing the WJ IV full battery using PAF with an oblique rotation, the test authors reported finding Heywood cases

This article was published Online First July 27, 2017.

Stefan C. Dombrowski, School Psychology Program, Department of Graduate Education, Leadership and Counseling, Rider University; Ryan J. McGill, School Psychology Program, School of Education, The College of William & Mary; Gary L. Canivez, Department of Psychology, Eastern Illinois University.

Correspondence concerning this article should be addressed to Stefan C. Dombrowski, School Psychology Program, Department of Graduate Education, Leadership and Counseling, Rider University, 2083 Lawrenceville Road, Lawrenceville, NJ 08648. E-mail: sdombrowski@rider.edu

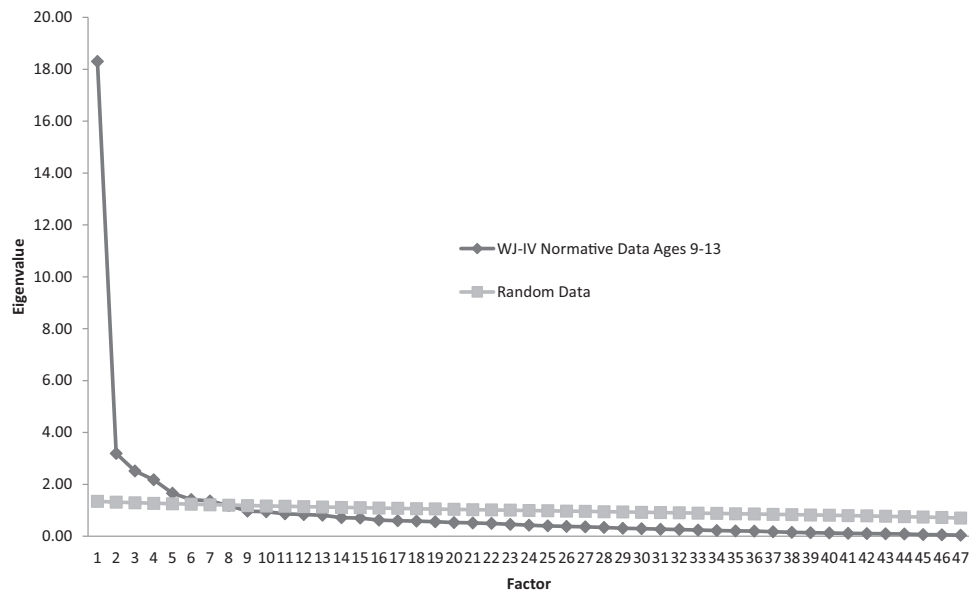


Figure 1. Scree plot of parallel analysis for WJ IV subtests (ages 9–13).

(i.e., communality >1.0), impermissible factors (i.e., less than two subtests saliently loading on a factor), and a lack of theoretical convergence (McGrew et al., 2014). The specific details of these findings were not presented in the *Technical Manual*. The test authors also conducted a principal components analysis (PCA) with varimax (orthogonal) rotation, arguing that these methods more readily yield an interpretable factor structure.

However, the use of these methods to disclose the latent structure of psychological tests is not without controversy (Fabrigar & Wegener, 2012; Gorsuch, 1983; Osborne, 2015). Although PCA falls under the general class of dimension reduction techniques, it does not consider the underlying latent structure of the variables,

using all the variance in the manifest variables, and therefore does not distinguish between dimensions of variance (e.g., shared and unique variance). Because of this, the components derived from PCA should not be interpreted as a reflection of latent dimensions (i.e., general factor or group-specific factors; Bentler & Kano, 1990; Preacher & MacCallum, 2003; Widaman, 1993). Additionally, the use of varimax rotation following factor extraction has been questioned. Gorsuch (1983) explained that “varimax is inappropriate if the theoretical expectation suggests a general factor may occur” (p. 185). Also varimax rotation may be questioned for use when factors are highly correlated as is often the case with ability measures like the WJ IV.

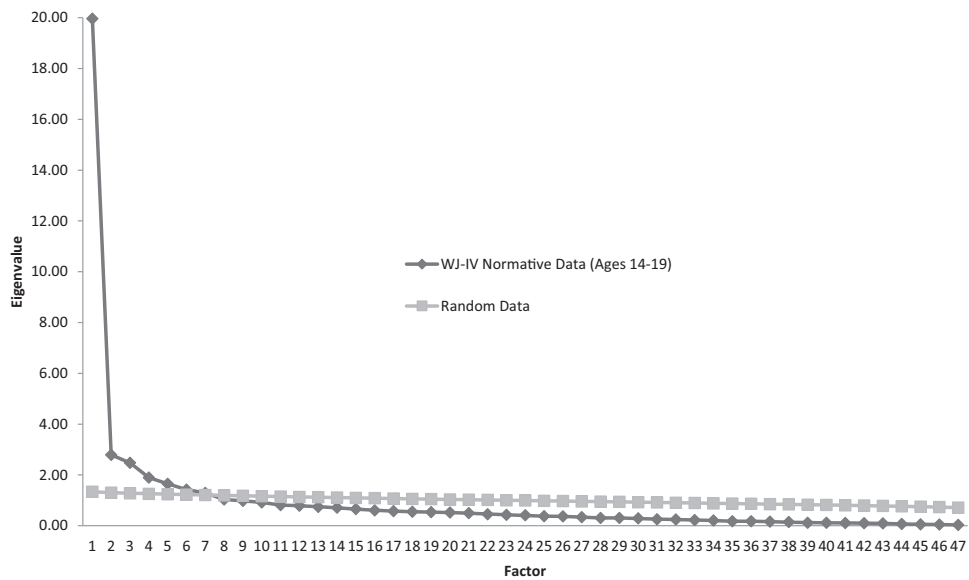


Figure 2. Scree plot of parallel analysis for WJ IV subtests (ages 14–19).

Table 1
Number of WJ-IV Factors Suggested for Extractions via EFA
Across Standardization Age Groups

Extractions criteria	Normative age groups	
	9–13	14–19
Eigenvalue > 1	8	8
Visual scree test	7–9	7–9
Horn's parallel analysis (HPA)	7	7
Minimum average partials (MAP)	7	7
Publisher theory	9	9

Note. EFA = exploratory factor analysis.

Alternatively, an oblique rotation (e.g., promax) is considered by many researchers to be more appropriate under these conditions (e.g., Osborne, 2015; Tabachnick & Fidell, 2007; Thompson, 2004). Although an oblique rotation for correlated traits may be preferred, it is not singularly sufficient and an additional step is often suggested when conducting exploratory factor analysis (EFA). Gorsuch (1983); Canivez (2016); Dombrowski, Canivez, Watkins, and Beaujean, (2015) and Thompson (2004) commented that higher-order factors are implicit in oblique rotations, particularly in the case of ability research, so it is recommended that these higher-order factors are extracted and examined.

A commonly used approach to examining and extracting higher-order factors is through the SL (Schmid & Leiman, 1957) procedure (Canivez, 2016; Carretta & Ree, 2001; Carroll, 1993, 1995, 2003; Dombrowski et al., 2017; Dombrowski, Canivez, & Watkins, 2017). Carroll (1993) utilized this procedure exclusively to develop his three-stratum theory of cognitive abilities, which was a major influence on the development of the WJ IV. Thus, it may have been worthwhile to consider its use when exploring the factor structure of the WJ IV.

There are additional factor analytic results that are informative and have yet to be analyzed including the correlations among the first-order factors, the percentage of variance accounted for by higher- and lower-order factors, communality estimates, and model-based reliability estimates (i.e., omega statistics). The body of literature on EFA methodology (e.g., Carroll, 1993, 1995, 1997, 2003; Gorsuch, 1983; McClain, 1996; Ree, Carretta, & Green, 2003; Thompson, 2004) has suggested that this information be included when presenting factor analytic results because it aids users in determining how an instrument should be interpreted. Unfortunately, this information was not included in the WJ IV *Technical Manual*, suggesting that the field's understanding of the measurement instrument is presently incomplete.

Purpose of the Current Study

To address this gap in the literature, the present study aimed to investigate the factor structure of the WJ IV full battery during school age (e.g., age 9 to 19) using PAF with an oblique rotation followed by the SL (Schmid & Leiman, 1957) orthogonalization procedure. Given the widespread use of the WJ family of instruments in clinical practice, it is believed that the results from the present investigation are important for establishing evidence-based assessment procedures for the WJ IV.

Method

Participants

Data for the WJ IV norms were collected from a nationally representative sample of 7,416 participants from age 2 through 90-plus. The WJ IV *Technical Manual* reports that the normative data controlled for census region, sex, country of birth, race, community type, parent education, and occupational level. Detailed demographic characteristics are provided in the WJ IV *Technical Manual*. For this study, two school aged (9 to 13 years and 14 to 19 years) subtest correlation matrices (47 by 47) were obtained from the *Technical Manual*. The 9 to 13 age group contained an average of 1,572 participants whereas the 14 to 19 age group contained an average of 1,685 participants.

Measurement Instrument

The Woodcock-Johnson IV total battery (WJ IV; Schrank, McGrew, & Mather, 2014a) contains three batteries that allow for a comprehensive assessment of cognitive ability, achievement, and oral language: Woodcock-Johnson IV Tests of Cognitive Ability (Schrank, McGrew, & Mather, 2014b), Woodcock-Johnson IV Tests of Achievement (Schrank, Mather, & McGrew, 2014a), and Woodcock-Johnson IV Test of Oral Language (Schrank, Mather, & McGrew, 2014b). The battery was designed to measure several CHC factors including Gc, Gf, Gwm, Gs, Ga, Gltr, Gv, Grw, and Gq (McGrew et al., 2014). The WJ IV also yields a general ability factor reflective of *g*. The *Technical Manual* provides correlation matrices for eight different age ranges (2 to 3; 4 to 5; 6 to 8; 9 to 13; 14 to 19; 20 to 39; 40 plus) to show the correlation among subtests (McGrew et al., 2014). The *Technical Manual* presents the WJ IV subtests with their relationship to *g* and CHC factors. Please see the instrument's examiner's manual for a synopsis of subtest demands.

Procedure

Subtest intercorrelation matrices for the WJ IV total battery configuration for ages 9–13 and 14–19 (47 × 47) were extracted from the *Technical Manual*. The two correlation matrices across the 9 to 19 age range were selected for several reasons. First, cognitive abilities have been shown to display a lack of invariance at younger age ranges (DiStefano & Dombrowski, 2006; Keith & Reynolds, 2010; Tusing & Ford, 2004). Second, the age period under investigation represents a range readily available in the schools for researchers and practitioners. Third, space limitations were also considered. Finally, this same age range was investigated in a prior EFA-SL study on the WJ III battery (e.g., Dombrowski & Watkins, 2013) so this may offer an element of comparison.

The correlation matrices were analyzed using several EFA methodologies. First, the intercorrelation matrices for the two age groups were evaluated using Bartlett's test of sphericity (Bartlett, 1954) and the Kaiser-Meyer-Olkin (KMO; Kaiser, 1974) statistic to ensure that they were suitable for factor analysis. Second, the intercorrelation matrices were subjected to PAF (Cudeck, 2000; Fabrigar, Wegener, MacCallum, & Strahan, 1999; Tabachnick & Fidell, 2007) with promax rotation ($k = 4$; Tataryn, Wood, & Gorsuch, 1999) because of the assumption of correlated factors (Gorsuch, 1983; Schmitt, 2011; Tabachnick & Fidell, 2007). Pattern coefficients of

Table 2

Subtest	Pattern (structure coefficients)										h ²
	I	II	III	IV	V	VI	VII	VIII	IV		
Writing Samples (Grw)	.85 (.73)	-.10 (.34)	.06 (.42)	-.20 (.32)	.06 (.43)	.07 (.26)	.19 (.13)	.10 (.13)	-.21 (-.06)	.63	
Reading Recall (Grw/Glr)	.80 (.69)	-.22 (.30)	-.24 (.36)	.05 (.38)	.28 (.54)	-.17 (.15)	.11 (.10)	.23 (.32)	.14 (.26)	.65	
Letter-Word Identification (Grw)	.77 (.88)	.20 (.61)	.08 (.57)	-.03 (.52)	-.07 (.49)	-.01 (.31)	-.01 (-.07)	-.03 (.04)	.06 (.21)	.80	
Passage Comprehension (Grw/Glr)	.75 (.81)	.20 (.59)	-.04 (.48)	-.10 (.49)	-.01 (.51)	.08 (.36)	.15 (.11)	.03 (.12)	.08 (.21)	.71	
Word Attack (Grw/Glr)	.69 (.75)	.01 (.48)	-.04 (.40)	.22 (.58)	-.15 (.38)	.17 (.47)	.06 (-.01)	-.11 (-.05)	-.04 (.06)	.66	
Oral Reading (Grw)	.52 (.70)	.17 (.51)	-.01 (.50)	.01 (.48)	-.08 (.43)	.11 (.35)	-.09 (-.12)	-.09 (.00)	.51 (.59)	.76	
Spelling (Grw)	.50 (.80)	.14 (.60)	.17 (.64)	.18 (.62)	.01 (.55)	-.03 (.35)	-.09 (-.10)	-.08 (.04)	.14 (.31)	.75	
Editing (Grw)	.46 (.77)	.21 (.62)	.02 (.56)	.17 (.61)	.10 (.57)	-.06 (.33)	-.20 (-.17)	.03 (.15)	.16 (.32)	.69	
Sentence Writing Fluency (Grw/Gs)	.45 (.69)	-.19 (.33)	.44 (.74)	.10 (.48)	.08 (.54)	-.09 (.21)	.02 (.01)	.08 (.18)	.14 (.36)	.73	
Sound Awareness (Grw/Ga)	.37 (.60)	-.05 (.42)	.06 (.43)	.20 (.59)	-.01 (.45)	.35 (.58)	.05 (.05)	-.09 (.01)	.02 (.14)	.54	
Picture Vocabulary (Gc)	.02 (.44)	.88 (.85)	-.06 (.32)	.02 (.50)	-.06 (.40)	-.05 (.27)	.06 (.12)	.09 (.22)	.06 (.16)	.74	
General Information (Gc)	-.08 (.38)	.82 (.77)	-.01 (.34)	-.10 (.42)	-.01 (.40)	-.05 (.29)	.07 (.13)	-.07 (.08)	.33 (.41)	.70	
Social Studies (Gc)	.01 (.50)	.78 (.82)	.03 (.39)	-.07 (.48)	.20 (.53)	.07 (.27)	-.08 (.01)	.06 (.19)	-.14 (.01)	.72	
Humanities (Gc)	-.13 (.41)	.72 (.77)	.01 (.35)	.01 (.52)	.12 (.48)	.13 (.41)	-.11 (.00)	.07 (.20)	.02 (.14)	.63	
Oral Vocabulary (Gc)	.11 (.55)	.69 (.82)	-.04 (.42)	.02 (.57)	.07 (.53)	.03 (.37)	.04 (.11)	.04 (.20)	.12 (.24)	.70	
Oral Comprehension (Gc)	.25 (.51)	.64 (.76)	-.08 (.31)	.10 (.54)	-.12 (.39)	-.01 (.33)	.26 (.29)	.07 (.20)	-.09 (.02)	.68	
Science (Gc)	.08 (.50)	.57 (.73)	-.11 (.30)	.11 (.53)	.30 (.54)	-.07 (.31)	-.08 (.01)	.08 (.19)	-.31 (-.17)	.69	
Reading Vocabulary (Grw/Gc)	.46 (.74)	.51 (.76)	-.03 (.48)	-.12 (.54)	-.01 (.54)	.11 (.40)	-.05 (-.02)	.15 (.24)	.17 (.30)	.76	
Pair Cancellation (Gs)	-.29 (.27)	.09 (.30)	.92 (.72)	-.04 (.34)	.02 (.38)	.08 (.20)	-.01 (.05)	.02 (.13)	-.26 (-.01)	.62	
Letter-Pattern Matching (Gs)	-.02 (.39)	-.10 (.25)	.81 (.77)	-.10 (.34)	.04 (.45)	.08 (.20)	.10 (.14)	.07 (.19)	.01 (.26)	.62	
Number-Pattern Matching (Per/Spd)	.27 (.51)	-.21 (.22)	.74 (.76)	-.15 (.32)	.05 (.47)	.02 (.16)	.14 (.15)	.17 (.26)	-.11 (.15)	.74	
Word Reading Fluency (Grw/Gs)	.19 (.56)	.03 (.39)	.68 (.81)	-.03 (.42)	-.06 (.47)	-.09 (.13)	-.05 (-.01)	.20 (.30)	.17 (.41)	.67	
Math Fact Fluency (Gq/Gs)	.15 (.59)	.02 (.42)	.57 (.78)	.05 (.45)	.21 (.58)	.16 (.15)	-.01 (.00)	-.13 (.04)	.10 (.33)	.68	
Sentence Reading Fluency (Grw/Gs)	.37 (.69)	.04 (.46)	.54 (.81)	.04 (.50)	-.06 (.52)	-.09 (.20)	.09 (.08)	-.01 (.13)	.23 (.45)	.78	
Rapid Picture Naming (Gs/Glr)	-.07 (.26)	.20 (.40)	.39 (.44)	.30 (.45)	-.20 (.26)	-.09 (.16)	.22 (.27)	.21 (.32)	-.16 (.01)	.42	
Nonword Repetition (Ga)	.10 (.37)	-.06 (.36)	-.10 (.27)	.76 (.68)	-.12 (.29)	.03 (.41)	.16 (.18)	-.12 (.03)	.06 (.13)	.51	
Sentence Repetition (Gwm)	.11 (.45)	.16 (.51)	-.05 (.33)	.75 (.71)	-.15 (.31)	-.13 (.32)	.02 (.05)	-.03 (.10)	-.03 (.07)	.55	
Verbal Attention (Gwm)	.09 (.46)	-.07 (.42)	-.08 (.37)	.74 (.73)	.13 (.47)	-.10 (.36)	-.07 (.01)	.08 (.23)	-.03 (.11)	.56	
Memory for Words (Aud Mem)	-.09 (.26)	-.07 (.34)	-.12 (.24)	.58 (.66)	.05 (.40)	.25 (.53)	-.01 (.12)	.27 (.39)	.05 (.15)	.56	
Object-Number Sequencing (Gwm)	-.32 (.24)	-.01 (.38)	.22 (.46)	.56 (.66)	.20 (.52)	.03 (.39)	.11 (.26)	.15 (.35)	-.01 (.17)	.58	
Understanding Directions (Gwm)	.06 (.41)	.08 (.46)	-.01 (.36)	.51 (.62)	.19 (.48)	-.08 (.34)	.25 (.29)	-.12 (.07)	-.11 (.03)	.49	
Number Series (Gf)	.45 (.72)	-.10 (.43)	.00 (.52)	-.02 (.46)	.70 (.78)	-.08 (.30)	-.11 (-.07)	-.06 (.08)	-.18 (.03)	.80	
Applied Problems (Cq)	.10 (.58)	.28 (.61)	.07 (.54)	-.11 (.48)	.65 (.80)	-.03 (.34)	.05 (.12)	-.12 (.09)	.03 (.22)	.72	
Calculation (Gq/Gs)	.28 (.67)	.02 (.47)	.21 (.63)	-.13 (.43)	.63 (.78)	-.07 (.27)	-.07 (-.03)	-.08 (.09)	-.06 (.17)	.73	
Analysis-Synthesis (Gf)	-.14 (.27)	.08 (.37)	.04 (.34)	-.11 (.38)	.61 (.67)	.23 (.42)	.17 (.30)	.12 (.30)	-.05 (.12)	.54	
Number Matrices (Gf)	.00 (.47)	.08 (.46)	.05 (.45)	.12 (.50)	.56 (.68)	.04 (.36)	-.22 (-.11)	.06 (.20)	-.05 (.13)	.53	
Concept Formation (Gf)	-.07 (.32)	.04 (.38)	-.05 (.33)	.11 (.47)	.52 (.64)	.15 (.43)	.18 (.28)	.00 (.20)	.05 (.19)	.48	
Story Recall (Glr)	.12 (.34)	.17 (.42)	-.07 (.26)	.11 (.40)	.31 (.49)	-.03 (.26)	.29 (.35)	.07 (.22)	-.17 (-.04)	.40	
Numbers Reversed (Gwm)	-.05 (.37)	.01 (.37)	.13 (.44)	.25 (.51)	.28 (.52)	.08 (.36)	-.03 (.06)	.01 (.16)	.10 (.24)	.36	
Sound Blending (Ga)	-.07 (.20)	.15 (.31)	-.02 (.15)	-.12 (.35)	-.02 (.29)	.72 (.69)	.07 (.13)	-.01 (.06)	.14 (.17)	.51	
Segmentation (Ga)	.21 (.36)	-.11 (.26)	-.03 (.20)	-.03 (.43)	.06 (.37)	.69 (.72)	.07 (.12)	.11 (.15)	-.15 (-.06)	.57	
Phonological Processing (Ga)	.17 (.51)	.06 (.47)	.07 (.41)	.13 (.62)	-.01 (.48)	.51 (.67)	-.19 (-.09)	.32 (.37)	-.02 (.13)	.68	
Spelling of Sounds (Ga/Grw)	.38 (.64)	-.13 (.37)	.10 (.45)	.13 (.56)	.07 (.47)	.46 (.65)	-.16 (-.17)	-.20 (-.13)	.02 (.13)	.70	
Visual-Auditory Learning (Glr)	-.02 (.20)	-.04 (.23)	-.03 (.21)	-.05 (.33)	.25 (.42)	.42 (.50)	.28 (.35)	-.01 (.13)	.16 (.23)	.40	
Picture Recognition (Gv)	.12 (.20)	.02 (.25)	.15 (.27)	.10 (.32)	-.08 (.27)	.07 (.23)	.66 (.67)	.03 (.18)	-.04 (.06)	.54	
Visualization (Gv)	-.03 (.28)	.01 (.33)	.01 (.30)	.08 (.42)	.33 (.51)	.26 (.47)	.35 (.41)	-.17 (.03)	.11 (.21)	.48	

Table 2 (continued)

Subtest	Pattern (structure coefficients)									<i>h</i> ²
	I	II	III	IV	V	VI	VII	VIII	IV	
Retrieval Fluency (Glr/Gs)	.03 (.33)	.25 (.45)	.25 (.42)	.01 (.41)	-.03 (.39)	.06 (.24)	.02 (.14)	.54 (.61)	-.13 (.05)	.55
Eigenvalue	18.30	3.18	2.51	2.17	1.65	1.41	1.36	1.17	.96	
Variance (%)	38.94	6.78	5.35	4.62	3.52	3.00	2.89	2.50	2.06	
Factor 1	1.0									
Factor 2	.56	1.0								
Factor 3	.58	.42	1.0							
Factor 4	.56	.60	.51	1.0						
Factor 5	.56	.51	.56	.56						
Factor 6	.35	.37	.24	.57		1.0				
Factor 7	-.08	.07	.03	.10	.15	.08	1.0			
Factor 8	.06	.15	.16	.21	.26	.07	.18	1.0		
Factor 9	.17	.13	.31	.17	.24	.07	.04	.13	1.0	

Note. *h*² = communality coefficient. Pattern coefficients > .30 are bolded (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective Cattell-Horn-Carroll theory Stratum I or II factors posited in the Woodcock-Johnson (fourth edition) Technical Manual is indicated following each subtest name.

.30 or higher were considered salient (Child, 2006; Schmitt, 2011). Next, multiple empirical factor extraction criteria were examined (Gorsuch, 1983) as well as factor interpretability and compliance with simple structure (Thurstone, 1947). Specifically, eigenvalues >1 (Kaiser, 1974), the scree test (Cattell, 1966), Horn's parallel analysis (HPA; Horn, 1965), and minimum average partials (MAP; Velicer, 1976) were examined. These procedures were conducted using O'Connor's (2000) SPSS syntax. An additional step was to extract the nine factors posited in the *Technical Manual*. Additionally, a higher-order factor analysis using the SL procedure was applied to the oblique first-order factors to elucidate the structure of the WJ IV using the SPSS syntax provided by Wolff and Preising (2005).

Results

Results from Bartlett's test of sphericity (Bartlett, 1950) for both age range analyses indicated that the correlation matrices were not random (9 to 13 age range $\chi^2 = 11,592.57$, $df = 153$, $p < .0001$; 14 to 19 age range $\chi^2 = 13,819.03$, $df = 153$, $p < .0001$). For the 9–13 and 14–19 age groups, the KMO (Kaiser, 1974) statistic was .867 and .894, respectively, well above the minimum standard of .60 for conducting a factor analysis suggested by Kline (1994). Measures of sampling adequacy for each variable were also within reasonable limits. Thus, the correlation matrices were judged to be appropriate for the factor analytic procedures that were employed.

Factor Extraction Criteria Comparison

PA (Horn, 1965) suggested that seven factors be extracted for both the 9–13 and 14–19 age groups (Figures 1 and 2). The MAP (Velicer, 1976) criterion also recommended extraction of seven factors for both age groups. The visual scree test indicated evidence for seven to nine factors for each age group. Factor extraction results are presented in Table 1. Seven factors were extracted in accord with factor extraction rules. Nine factors were extracted in accord with the test publisher's proposed theoretical structure reported in the *Technical Manual*. Eight factors were also extracted. A nine-factor extraction had the greatest linkage to theory—though only seven interpretable factors were uncovered—and was deemed most interpretable across the two age group extractions.

Exploratory and Hierarchical Factor Analysis

Nine-factor extraction. The 9–13 and 14–19 school-aged correlation matrices were subjected to PAF with an oblique (promax) rotation. Tables 2 and 3 present the results of the PAF analyses for the age 9–13 and 14–19 correlation matrices in accord with a nine-factor extraction. These tables also include pattern and structure coefficients, eigenvalues for retained factors, percentage of variance accounted for by each factor, communality estimates, and the correlations among the extracted factors. This information was not included in the *Technical Manual*. The age 9 to 13 analysis (see Table 2) indicated that the first factor accounted for 38.94% of the variance. This exceeded the variance (6.84%) accounted for by the second factor for the 9 to 13 age group. Absolute value correlations among the extracted nine factors ranged from .04 to .60 (*Mdn* = .175). The age 14 to 19 analysis (see Table 3) indicated that the first factor accounted for 42.48%

Table 3
Age 14- to 19 WJ-IV Principal Axis Factor With Promax Rotation (9 Factors)

Subtest	Pattern (structure coefficients)									<i>h</i> ²
	I	II	III	IV	V	VI	VII	VIII	IV	
General Information (Gc)	.98 (.82)	.05 (.46)	-.15 (.40)	-.09 (.48)	.11 (.44)	-.15 (.39)	.11 (.11)	-.15 (-.19)	-.09 (.15)	.74
Picture Vocabulary (Gc)	.94 (.86)	-.05 (.42)	.04 (.49)	-.04 (.55)	.01 (.43)	-.11 (.43)	.08 (.09)	.14 (.06)	.08 (.21)	.76
Social Studies (Gc)	.79 (.82)	-.03 (.44)	.01 (.51)	-.09 (.55)	-.07 (.42)	.27 (.63)	-.04 (.06)	.13 (.10)	-.04 (.03)	.74
Humanities (Gc)	.76 (.80)	-.07 (.41)	-.13 (.44)	.11 (.60)	.06 (.49)	.10 (.53)	-.05 (.05)	.03 (.04)	-.05 (.07)	.67
Oral Vocabulary (Gc)	.75 (.86)	.00 (.52)	.06 (.58)	.00 (.62)	.08 (.53)	.05 (.57)	.02 (.08)	.01 (-.04)	-.01 (.13)	.74
Oral Comprehension (Gc)	.75 (.77)	-.13 (.35)	.24 (.56)	.07 (.58)	-.06 (.42)	-.07 (.48)	.17 (.18)	.19 (.17)	-.06 (.02)	.70
Reading Vocabulary (Grw/Gc)	.65 (.85)	.02 (.57)	.32 (.72)	-.08 (.60)	.03 (.47)	.03 (.53)	-.03 (-.02)	-.02 (-.13)	.08 (.23)	.79
Science (Gc)	.57 (.75)	-.20 (.36)	.14 (.55)	.06 (.59)	-.08 (.44)	.38 (.67)	-.03 (.09)	.14 (.15)	.01 (.01)	.70
Word Reading Fluency (Grw/Gs)	.08 (.48)	.91 (.83)	.01 (.44)	-.08 (.41)	-.10 (.26)	-.04 (.35)	-.12 (-.06)	.23 (-.06)	.14 (.31)	.75
Number-Pattern Matching (PerSpd)	-.16 (.32)	.85 (.73)	.21 (.47)	-.06 (.39)	-.11 (.26)	.05 (.48)	.14 (.20)	.10 (.00)	-.31 (-.16)	.71
Letter-Pattern Matching (Gs)	-.15 (.34)	.83 (.73)	-.02 (.36)	.01 (.44)	.14 (.41)	-.04 (.43)	.14 (.24)	.13 (.00)	-.09 (.06)	.62
Pair Cancellation (Gs)	.03 (.36)	.78 (.63)	-.17 (.28)	-.08 (.39)	.18 (.41)	.04 (.43)	-.12 (.04)	.27 (.17)	-.21 (-.10)	.56
Sentence Reading Fluency (Grw/Gs)	.10 (.58)	.71 (.84)	.23 (.60)	-.02 (.53)	-.06 (.36)	-.09 (.42)	.05 (.07)	.11 (-.16)	.20 (.38)	.78
Math Fact Fluency (Gq/Gs)	-.01 (.48)	.64 (.76)	.01 (.46)	.02 (.46)	-.17 (.28)	.30 (.55)	-.01 (.09)	-.03 (-.19)	.06 (.20)	.63
Sentence Writing Fluency (Grw/Gs)	-.15 (.46)	.61 (.77)	.30 (.61)	.07 (.50)	-.07 (.33)	.06 (.45)	.00 (.04)	.00 (-.20)	.10 (.25)	.65
Writing Samples (Grw)	-.04 (.44)	.05 (.45)	.76 (.73)	-.16 (.43)	.04 (.39)	.14 (.53)	.27 (.27)	-.02 (-.06)	-.06 (-.03)	.65
Word Attack (Grw/Glr)	-.01 (.54)	-.12 (.40)	.71 (.79)	.17 (.61)	.17 (.50)	-.04 (.44)	-.01 (.00)	.08 (.03)	.04 (.07)	.68
Letter-Word Identification (Grw)	.27 (.70)	.12 (.60)	.71 (.88)	-.05 (.58)	-.02 (.41)	-.06 (.47)	-.02 (-.07)	-.02 (-.17)	.00 (.15)	.82
Passage Comprehension (Grw/Glr)	.28 (.69)	.07 (.58)	.61 (.80)	-.15 (.56)	.12 (.51)	.04 (.55)	.13 (.13)	-.01 (-.12)	.05 (.16)	.74
Reading Recall (Grw/Glr)	-.21 (.36)	.02 (.44)	.61 (.60)	-.06 (.37)	-.08 (.26)	.31 (.43)	.15 (.17)	.06 (-.11)	.47 (.43)	.60
Spelling (Grw)	.24 (.71)	.22 (.68)	.37 (.76)	.22 (.67)	-.05 (.43)	-.01 (.50)	-.07 (-.06)	-.13 (-.24)	-.03 (.16)	.75
Oral Reading (Grw)	.24 (.65)	.17 (.63)	.34 (.68)	.07 (.55)	.21 (.47)	-.16 (.32)	-.10 (-.13)	-.33 (-.47)	.12 (.37)	.78
Sound Awareness (Grw/Ga)	-.03 (.51)	-.01 (.45)	.33 (.59)	.19 (.60)	.30 (.59)	.10 (.50)	.02 (.11)	.03 (.00)	.12 (.15)	.52
Verbal Attention (Gwm)	.02 (.50)	.00 (.41)	.00 (.47)	.80 (.76)	-.16 (.38)	.07 (.49)	-.02 (.08)	-.03 (.05)	-.15 (-.08)	.61
Nonword Repetition (Ga)	-.11 (.37)	-.12 (.28)	.07 (.37)	.77 (.67)	.12 (.45)	-.16 (.29)	.11 (.16)	-.01 (.04)	.06 (.10)	.49
Sentence Repetition (Gwm)	.15 (.53)	-.09 (.34)	.13 (.47)	.72 (.71)	-.15 (.35)	-.10 (.34)	.01 (.04)	.19 (.15)	.14 (.16)	.58
Memory for Words (Aud Mem)	-.02 (.40)	-.01 (.31)	-.10 (.31)	.70 (.68)	.15 (.51)	-.07 (.41)	.10 (.22)	.08 (.18)	-.10 (-.07)	.52
Object-Number Sequencing (Gwm)	.01 (.46)	.27 (.51)	-.30 (.26)	.55 (.68)	.07 (.52)	.15 (.56)	.15 (.33)	.12 (.16)	-.02 (.02)	.62
Understanding Directions (Gwm)	-.09 (.42)	-.06 (.36)	.12 (.41)	.46 (.61)	-.01 (.43)	.22 (.51)	.17 (.29)	.18 (.17)	.23 (.17)	.50
Numbers Reversed (Gwm)	.03 (.48)	.15 (.49)	-.03 (.42)	.34 (.60)	.14 (.50)	.17 (.54)	.03 (.16)	-.11 (-.05)	-.13 (-.04)	.45
Editing (Grw)	.28 (.73)	.13 (.63)	.27 (.73)	.32 (.70)	-.17 (.38)	.15 (.57)	-.13 (-.09)	-.18 (-.23)	-.10 (.08)	.77
Sound Blending (Ga)	.14 (.44)	-.06 (.29)	.00 (.34)	.05 (.47)	.68 (.71)	-.06 (.37)	-.05 (.08)	-.06 (.01)	-.06 (.01)	.52
Segmentation (Ga)	-.08 (.37)	-.10 (.27)	.34 (.49)	.01 (.49)	.65 (.72)	-.02 (.45)	.08 (.20)	.04 (.14)	-.16 (-.15)	.62
Visual-Auditory Learning (Glr)	.08 (.35)	-.01 (.28)	-.01 (.23)	-.13 (.33)	.61 (.62)	.02 (.34)	.17 (.29)	.04 (.04)	.20 (.21)	.44
Spelling of Sounds (Ga/Grw)	-.20 (.49)	.07 (.51)	.41 (.68)	.10 (.61)	.52 (.70)	.11 (.51)	-.19 (-.07)	-.06 (-.10)	.03 (.09)	.71
Phonological Processing (Ga)	.16 (.62)	.07 (.47)	.14 (.57)	.14 (.65)	.41 (.68)	.09 (.54)	-.25 (-.09)	.19 (.16)	-.02 (.02)	.68
Visualization (Gv)	.01 (.41)	-.01 (.39)	.00 (.33)	.11 (.48)	.35 (.58)	.19 (.51)	.30 (.41)	-.16 (-.10)	.10 (.15)	.50
Number Series (Gf)	-.13 (.52)	-.02 (.53)	.36 (.65)	-.07 (.51)	-.08 (.41)	.88 (.84)	-.10 (.10)	-.06 (-.08)	.15 (.09)	.82
Calculation (Cq/Gs)	.07 (.61)	.23 (.67)	.15 (.60)	-.13 (.53)	.00 (.47)	.68 (.80)	-.07 (.11)	-.14 (-.18)	.04 (.10)	.78
Number Matrices (Gf)	.13 (.58)	.03 (.48)	-.08 (.44)	.10 (.55)	.06 (.47)	.65 (.71)	-.25 (-.02)	.00 (.01)	.08 (.07)	.61
Applied Problems (Gq)	.34 (.72)	.10 (.61)	-.01 (.54)	-.09 (.57)	.08 (.54)	.57 (.78)	-.01 (.17)	-.14 (-.15)	.07 (.14)	.76
Concept Formation (Gf)	.01 (.46)	-.03 (.40)	-.05 (.32)	-.04 (.48)	.39 (.62)	.45 (.61)	.22 (.42)	.14 (.11)	.38 (.30)	.61
Analysis-Synthesis (Gf)	.10 (.42)	.07 (.37)	-.15 (.25)	-.01 (.43)	.25 (.53)	.43 (.65)	.22 (.42)	.00 (.10)	-.04 (-.05)	.53
Picture Recognition (Gv)	.06 (.18)	.07 (.17)	.17 (.15)	.12 (.28)	.06 (.28)	-.27 (.20)	.69 (.67)	.20 (.22)	.06 (.05)	.55
Story Recall (Glr)	.20 (.44)	-.11 (.31)	.07 (.33)	.17 (.46)	-.07 (.36)	.26 (.55)	.45 (.52)	-.07 (.01)	.02 (.03)	.51
Rapid Picture Naming (Gs/Glr)	.09 (.30)	.38 (.34)	.00 (.21)	.16 (.40)	.02 (.30)	-.17 (.26)	.15 (.23)	.56 (.45)	.10 (.07)	.46

Table 3 (continued)

Subtest	Pattern (structure coefficients)									h^2
	I	II	III	IV	V	VI	VII	VIII	IV	
Retrieval Fluency (Glr/Gs)	.29 (.47)	.35 (.43)	-.07 (.29)	.05 (.45)	.02 (.37)	.03 (.44)	.07 (.19)	.41 (.34)	-.04 -.03)	.45
Eigenvalue	19.96	2.76	2.47	1.89	1.65	1.42	1.29	1.03	.97	
Variance (%)	42.48	5.92	5.26	4.02	3.51	3.03	2.75	2.20	2.07	
Factor 1	1.0									
Factor 2	.57	1.0								
Factor 3	.61	.55	1.0							
Factor 4	.67	.56	.60	1.0						
Factor 5	.52	.42	.43	.61	1.0					
Factor 6	.58	.52	.50	.59	.54	1.0				
Factor 7	.04	.08	-.05	.12	.21	.29	1.0			
Factor 8	-.07	-.23	-.12	.05	.08	.09	.13	1.0		
Factor 9	.19	.25	.08	.09	.04	-.08	-.04	-.31	1.0	

Note. h^2 = communality coefficient. Pattern coefficients $> .30$ are bolded (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective Cattell-Horn-Carroll theory Stratum I or II factors posited in the Woodcock-Johnson (fourth edition) Technical Manual is indicated following each subtest name.

of the variance. This exceeded the variance (5.92%) accounted for by the second factor. Absolute value correlations among the extracted nine factors ranged from .04 to .67 ($Mdn = .20$). Moderate to high correlation among factors, along with extant intelligence test theory, suggests the possible presence of a higher-order factor which needed to be extracted and examined (Gorsuch, 1983; Thompson, 2004).

Seven-factor extraction. The 9–13 and 14–19 school-aged correlation matrices were subjected to PAF with oblique (promax) rotation. Tables A1 and A2 (see the online supplemental materials) presents the results of the PAF analyses for the age 9–13 and 14–19 correlation matrices in accord with a seven-factor extraction. Tables A1 and A2 include pattern and structure coefficients, eigenvalues for retained factors, percentage of variance accounted for by each factor, communality estimates, and correlations among the extracted factors. The age 9 to 13 analysis (Table A1) indicated that the first factor accounted for 38.94% of the variance. This surpassed the variance (6.78%) accounted for by the second factor for the 9 to 13 age group. Correlations among the nine extracted factors ranged from .04 to .60 ($Mdn = .175$). The age 14 to 19 analysis (Table A2) indicated that the first factor accounted for 42.48% of the variance. This surpassed the variance (5.92%) accounted for by the second factor. Absolute value correlations among the seven extracted factors ranged from .02 to .64 ($Mdn = .46$). Moderate to high correlations among the factors suggested the possible presence of a higher-order factor which needed to be extracted and examined (Gorsuch, 1983; Thompson, 2004).

SL hierarchical analyses: nine first-order factors. Results from the SL procedure for ages 9–13 and 14–19 with the nine-factor solution are presented in Tables 4 and 5. For all analyses the results included the variance attributed to the general factor and group factors. These results are not included in the WJ IV *Technical Manual* and therefore serve to supplement analyses contained in the manual. In the 9 to 13 analysis, the general factor accounted for 32.6% of the total variance and 51.8% of the common variance, exceeding that accounted for by the lower-order group factors (Table 4; 1.9% to 5.4% total variance; 3.0% to 8.5% common variance). The general factor also accounted for between 10% and 53% ($Mdn = 34.5\%$) of individual subtest variance. In the 14 to 19 analysis, the general factor accounted for 36.8% of the total variance and 55.6% of the common variance, exceeding that accounted for by the lower order factors (Table 5; 2.9% to 7.8% total variance; 1.9% to 5.1% common variance). The general factor also accounted for between 7% and 57% ($Mdn = 37.5\%$) of individual subtest variance in the 14 to 19 analysis. The first- and second-order factors combined to measure 63.0% and 66.1% of the respective variance in the WJ IV, reflecting 37.0% and 33.9% unique variance in the 9 to 13 and 14 to 19 analyses. These results demonstrate a robust manifestation of general intelligence in the WJ IV where the combined influence of general intelligence and uniqueness exceeded the contributions made by the first-order group factors.

SL hierarchical analyses: seven first-order factors. Results from the Schmid and Leiman (1957) procedure with the seven-factor solution are presented in Tables A3 and A4 (see the online supplemental materials). In the 9 to 13 SL analysis (Table A3), the general factor accounted for 31.9% of the total variance and 53.1% of the common variance, exceeding that accounted for by the lower-order group factors (3.0% to 5.6% total variance; 5.0% to 9.3% common variance). The general factor also accounted for between 10% and

Table 4
WJ IV Sources of Variance According to a Schmid-Leiman Orthogonalization (9 Factor) Ages 9 to 13

Second-order factor	Subtest	First-order factors																				
		g	S ²	F1	S ²	F2	S ²	F3	S ²	F4	S ²	F5	S ²	F6	S ²	F7	S ²	F8	S ²	F9	S ²	h ²
Writing Samples (Grw)		.50	.25	.58	.33	-.07	.00	.04	.00	-.12	.01	.04	.00	.06	.00	.19	.04	.10	.01	-.20	.04	.69
	Reading Recall (Grw/Glr)	.53	.28	.54	.30	-.16	.02	-.18	.03	.03	.00	.18	.03	-.15	.02	.11	.01	.23	.05	.14	.02	.77
	Letter-Word Identification (Grw)	.68	.47	.53	.28	.15	.02	.06	.00	-.02	.00	-.05	.00	-.01	.00	-.01	.00	-.03	.00	.06	.00	.77
	Passage Comprehension (Grw/Glr)	.65	.43	.51	.26	.15	.02	-.03	.00	-.06	.00	-.01	.00	.07	.00	.15	.02	.03	.00	.07	.01	.74
Word Attack (Grw/Glr)		.60	.36	.47	.22	.01	.00	-.03	.00	.13	.02	-.10	.01	.15	.02	.06	.00	-.10	.01	-.04	.00	.65
	Oral Reading (Grw)	.61	.37	.35	.13	.12	.01	.00	.00	.01	.00	-.05	.00	.10	.01	-.09	.01	-.09	.01	.49	.24	.78
	Spelling (Grw)	.73	.53	.34	.12	.10	.01	.13	.02	.11	.01	.01	.00	-.02	.00	-.09	.01	-.08	.01	.13	.02	.72
	Editing (Grw)	.72	.52	.31	.10	.15	.02	.02	.00	.10	.01	.06	.00	-.05	.00	-.20	.04	.08	.01	.15	.02	.72
Sentence Writing Fluency (Grw/Gs)		.63	.40	.30	.09	-.14	.02	.32	.10	.06	.00	.05	.00	-.07	.01	.02	.00	.03	.00	.14	.02	.64
	Sound Awareness (Grw/Ga)	.60	.36	.25	.06	-.04	.00	.04	.00	.12	.01	-.01	.00	.29	.09	.05	.00	-.09	.01	.02	.00	.54
	Picture Vocabulary (Gc)	.57	.32	.01	.00	.63	.40	-.05	.00	.01	.00	-.04	.00	-.04	.00	.06	.00	.09	.01	.06	.00	.74
	General Information (Gc)	.53	.28	-.05	.00	.59	.35	-.01	.00	-.06	.00	.00	.00	.04	.00	.07	.01	-.07	.01	.32	.10	.75
Social Studies (Gc)		.61	.37	.01	.00	.56	.31	.02	.00	-.04	.00	.13	.02	-.06	.00	-.08	.01	.06	.00	-.13	.02	.73
	Humanities (Gc)	.59	.34	-.09	.01	.52	.27	.00	.00	.01	.00	.08	.01	.11	.01	-.11	.01	.07	.01	.02	.00	.65
	Oral Vocabulary (Gc)	.67	.44	.08	.01	.49	.24	-.03	.00	.01	.00	.05	.00	.03	.00	.04	.00	.04	.00	.11	.01	.71
	Oral Comprehension (Gc)	.58	.33	.17	.03	.46	.21	-.06	.00	.06	.00	-.08	.01	-.01	.00	.26	.07	.07	.00	-.09	.01	.66
Reading Vocabulary (Grw/Gc)		.60	.35	.06	.00	.41	.17	-.08	.01	.06	.00	.19	.04	-.06	.00	-.08	.01	.08	.01	.16	.03	.78
	Science (Gc)	.70	.49	.32	.10	.36	.13	-.03	.00	-.07	.00	-.01	.00	.09	.01	-.05	.00	.14	.02	.16	.03	.78
	Pair Cancellation (Gs)	.43	.18	-.20	.04	.07	.00	.68	.46	-.03	.00	.01	.00	.07	.01	-.01	.00	.02	.00	-.25	.06	.75
	Letter-Pattern Matching (Gs)	.49	.24	-.02	.00	-.07	.00	.60	.36	-.06	.00	.03	.00	.07	.00	.10	.01	.06	.00	.01	.00	.63
Number-Pattern Matching (PerSpd)		.50	.25	.18	.03	-.15	.02	.54	.29	-.09	.01	.03	.00	.01	.00	.14	.02	.16	.03	-.10	.01	.67
	Word Reading Fluency (Grw/Gs)	.59	.34	.13	.02	.02	.00	.50	.25	-.02	.00	-.04	.00	-.07	.01	-.05	.00	.19	.04	.17	.03	.69
	Math Fact Fluency (Gq/Gs)	.63	.39	.10	.01	.02	.00	.42	.17	.03	.00	.14	.02	-.14	.02	-.01	.00	-.12	.02	.09	.01	.64
	Sentence Reading Fluency (Grw/Gs)	.67	.44	.25	.06	.03	.00	.40	.16	.02	.00	-.04	.00	-.08	.01	.09	.01	-.01	.00	.22	.05	.73
Rapid Picture Naming (Gs/Glr)		.42	.18	-.05	.00	.14	.02	.29	.08	.17	.03	-.13	.02	-.07	.01	.21	.05	.21	.04	-.15	.02	.44
	Nonword Repetition (Ga)	.50	.25	.07	.00	-.05	.00	-.07	.00	.44	.20	-.08	.01	.03	.00	.16	.02	-.12	.01	.06	.00	.51
	Sentence Repetition (Gwm)	.56	.32	.07	.01	.11	.01	-.04	.00	.44	.20	-.10	.01	-.11	.01	.02	.00	-.03	.00	-.03	.00	.56
	Verbal Attention (Gwm)	.61	.38	.06	.00	-.05	.00	-.06	.00	.44	.19	.08	.01	-.09	.01	-.07	.01	.08	.01	-.03	.00	.60
Memory for Words (Aud Mem)		.51	.26	-.06	.00	-.05	.00	-.09	.01	.34	.12	.03	.00	.21	.04	-.01	.00	.27	.07	.05	.00	.51
	Object-Number Sequencing (Gwm)	.57	.33	-.22	.05	-.01	.00	.16	.03	.33	.11	.13	.02	.03	.00	.11	.01	.14	.02	-.01	.00	.56
	Understanding Directions (Gwm)	.57	.32	.04	.00	.06	.00	-.01	.00	.30	.09	.12	.01	-.07	.01	.24	.06	-.12	.01	-.10	.01	.52
	Number Series (Gf)	.67	.45	.31	.10	-.07	.01	.00	.00	-.01	.00	.45	.20	-.07	.00	-.11	.01	-.06	.00	-.18	.03	.80
Applied Problems (Gq)		.70	.48	.07	.00	.20	.04	.05	.00	-.07	.00	.42	.17	-.02	.00	.05	.00	-.12	.01	.03	.00	.73
	Calculation (Gq/Gs)	.67	.45	.19	.04	.02	.00	.16	.02	-.08	.01	.40	.16	-.06	.00	-.07	.01	-.08	.01	-.06	.00	.70
	Analysis-Synthesis (Gf)	.50	.25	-.10	.01	.06	.00	.03	.00	-.07	.00	.39	.15	.19	.04	.17	.03	.12	.01	-.04	.00	.50
	Number Matrices (Gf)	.61	.37	.00	.00	.06	.00	.04	.00	.00	.07	.00	.36	.13	.03	.00	-.22	.05	.06	.00	-.05	.00
Concept Formation (Gf)		.54	.29	-.05	.00	.03	.00	-.04	.00	.07	.00	.33	.11	.13	.02	.18	.03	.00	.00	.05	.00	.46
	Story Recall (Glr)	.46	.21	.08	.01	.12	.01	-.05	.00	.06	.00	.20	.04	-.02	.00	.29	.08	.06	.00	-.16	.03	.39
	Numbers Reversed (Gwm)	.54	.29	-.04	.00	.01	.00	.10	.01	.15	.02	.18	.03	.07	.00	-.03	.00	.01	.00	.09	.01	.37
	Sound Blending (Ga)	.35	.12	-.04	.00	.11	.01	-.02	.00	-.07	.01	-.01	.00	.62	.38	.07	.00	-.01	.00	.13	.02	.54
Segmentation (Ga)		.43	.18	.15	.02	-.08	.01	-.03	.00	-.02	.00	.04	.00	-.02	.00	.07	.00	.11	.01	-.14	.02	.59
	Phonological Processing (Ga)	.62	.39	.11	.01	.04	.00	.05	.00	.07	.01	-.01	.00	.43	.18	-.19	.04	.31	.10	-.02	.00	.73
	Spelling of Sounds (Ga/Grw)	.60	.36	.26	.07	-.09	.01	.07	.00	.08	.01	.05	.00	.39	.15	-.16	.02	-.20	.04	.01	.00	.66
	Visual-Auditory Learning (Glr)	.38	.14	-.01	.00	-.03	.00	-.02	.00	-.03	.00	.16	.02	.35	.13	.28	.08	-.01	.00	.15	.02	.39

Table 4 (continued)

Subtest	Second-order factor		First-order factors																		h^2
	g	S^2	F1	S^2	F2	S^2	F3	S^2	F4	S^2	F5	S^2	F6	S^2	F7	S^2	F8	S^2	F9	S^2	
Picture Recognition (Gv)	.32	.10	.08	.01	.01	.00	.11	.01	.06	.00	-.05	.00	.06	.00	.66	.44	.03	.00	-.04	.00	.57
Visualization (Gv)	.47	.22	-.02	.00	.01	.00	.01	.00	.05	.00	.21	.05	.22	.05	.35	.12	-.16	.03	.10	.01	.48
Retrieval Fluency (Glr/Gs)	.47	.22	.02	.00	.18	.03	.19	.03	.01	.00	-.02	.00	.05	.00	.02	.00	.53	.28	-.13	.02	.58
Common variance (%)	51.8		8.5		8.2		7.0		3.7		4.4		5.4		4.5		3.0		3.4		63.0
Total variance (%)	32.6		5.4		5.2		4.4		2.3		2.7		3.4		2.9		1.9		2.1		

Note. g = general intelligence factor; S^2 = variance explained; h^2 = communality. Loadings $\geq .30$ are bolded (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective Cattell-Horn-Carroll theory Stratum I or II factors posited in the Woodcock-Johnson (fourth edition) Technical Manual is indicated following each subtest name.

52% ($Mdn = 36.5\%$) of individual subtest variance in the 9 to 13 analysis. In the age 14 to 19 analysis (Table A4), the general factor accounted for 36.4% of the total variance and 59.2% of the common variance, exceeding that accounted for by the lower-order group factors (2.7% to 5.0% total variance; 4.3% to 8.1% common variance). The general factor also accounted for between 7% and 56% ($Mdn = 37.5\%$) of individual subtest variance in the 14 to 19 analysis. The first- and second-order factors combined to measure 60.1% and 61.5% of the respective variance in the WJ IV, reflecting 39.9% and 38.5% unique variance in the age 9–13 and 14–19 analyses, respectively. These results demonstrated a robust manifestation of general intelligence in the WJ IV where the combined influence of general intelligence and uniqueness exceeded the contributions made by the first-order group factors.

Eight-factor EFA and SL analysis: ages 9 to 13 and 14 to 19.

The correlation matrices for both age ranges were subjected to PAF with promax rotation followed by the SL transformation. Results of an eight-factor extraction from these analyses yielded a theoretically plausible seven-factor solution at age 9 to 13 and a six-factor solution at age 14 to 19. These results are provided in the online supplemental materials (Tables A5 to A8) but were deemed inferior to the nine-factor solution.

Discussion

The WJ IV represents the latest iteration of the WJ family of products and is poised to take the place of its predecessor as one of the preeminent CHC-based measurement instruments in school psychology practice and research. Within the professional literature, it has frequently been posited that the WJ IV full test battery measures nine distinct CHC-related cognitive-achievement factors (Gc, Gf, Ga, Gv, Gltr, Gwm, Gs, Grw, Gq) in addition to a higher-order general intelligence factor. In the present EFA study, the extraction of nine factors located only seven CHC-related dimensions including Gc, Grw, Gs, Gwm, Ga, combined Gq/Gf, and Gv across both age ranges (ages 9–13, see Table 4; ages 14–19, see Table 5). Additionally, across both age groups, the subtest alignment with several of the group factors displayed occasional migration away from theoretically posited factors and frequent cross-loadings with divergent factors (Tables 6 and 7 present a factor structure summary detailing the pattern of subtest major loadings and cross-loadings via the SL analyses). The most notable were the academic fluency subtests (Math Fact Fluency, Word Reading Fluency, Sentence Reading Fluency, and Sentence Writing Fluency). These subtests had higher loadings on the Gs group factor than on their respective academic factors although one subtest (e.g., Sentence Writing Fluency) at age 9 to 13 displayed a cross-loading with the Grw factor. Other examples included Reading Vocabulary which had a higher loading on the Gc (.36 for ages 9 to 13; .38 for ages 14 to 19) factor than on the Grw (.32 for ages 9 to 13; .23 for ages 14 to 19) factor.

The Gc, Grw, Ga, and the combined Gf/Gq factors generally contained theoretically consistent subtest alignment with occasional subtest migration (see Tables 6 and 7) for the nine-factor solution. For instance, Nonword Repetition (Ga) saliently loaded on the Gwm (.44 for ages 9 to 13, .43 for ages 14 to 19) factor, but failed to align with Ga in both age groups. Results did not locate distinct Gq and Gf group factors but instead found evidence for a combined Gf/Gq factor. Results also did not locate a distinct Gltr

Table 5
WJ IV Sources of Variance According to a Schmid-Leiman Orthogonalization (9 Factor) Ages 14 to 19

Subtest	Second-order factor		First-order factors																		
	g	S ²	F1	S ²	F2	S ²	F3	S ²	F4	S ²	F5	S ²	F6	S ²	F7	S ²	F8	S ²	F9	S ²	h ²
General Information (Gc)	.62	.38	.58	.33	.04	.00	-.11	.01	-.05	.00	.08	.01	-.11	.01	.11	.01	-.15	.02	-.09	.01	.79
Picture Vocabulary (Gc)	.66	.43	.55	.30	-.04	.00	.03	.00	-.02	.00	.00	.00	-.07	.01	.08	.01	.14	.02	.08	.01	.78
Social Studies (Gc)	.69	.47	.47	.22	-.02	.00	.00	.00	-.05	.00	-.05	.00	.19	.03	-.04	.00	.13	.02	-.04	.00	.75
Humanities (Gc)	.67	.45	.45	.20	-.05	.00	-.09	.01	.06	.00	.05	.00	.07	.00	-.05	.00	.03	.00	-.05	.00	.68
Oral Vocabulary (Gc)	.74	.55	.44	.19	.00	.00	.04	.00	.00	.00	.06	.00	.04	.00	.02	.00	.01	.00	-.01	.00	.75
Oral Comprehension (Gc)	.65	.42	.44	.19	-.10	.01	.17	.03	.04	.00	-.05	.00	-.05	.00	.17	.03	.19	.04	-.06	.00	.72
Reading Vocabulary (Grw/Gc)	.75	.57	.38	.14	.01	.00	.23	.05	-.04	.00	.02	.00	.02	.00	-.03	.00	-.02	.00	.08	.01	.77
Science (Gc)	.68	.46	.34	.11	-.14	.02	.10	.01	.03	.00	-.06	.00	.26	.07	-.03	.00	.14	.02	.01	.00	.70
Word Reading Fluency (Grw/Gs)	.54	.29	.05	.00	.65	.42	.01	.00	-.05	.00	-.07	.01	-.03	.00	-.12	.01	.23	.05	.13	.02	.80
Number-Pattern Matching (PerSpd)	.51	.26	-.09	.01	.60	.36	.15	.02	-.03	.00	-.08	.01	.04	.00	.14	.02	.10	.01	-.31	.10	.78
Letter-Patten Matching (Gs)	.52	.27	-.09	.01	.59	.34	-.02	.00	.00	.00	.10	.01	-.03	.00	.14	.02	.13	.02	-.09	.01	.68
Pair Cancellation (Gs)	.48	.23	.02	.00	.55	.30	-.12	.01	-.05	.00	.13	.02	.03	.00	-.11	.01	.27	.07	-.21	.04	.69
Sentence Reading Fluency (Grw/Gs)	.65	.43	.06	.00	.50	.25	.16	.02	-.01	.00	-.04	.00	-.06	.00	.05	.00	.11	.01	.20	.04	.77
Math Fact Fluency (Gq/Gs)	.59	.35	.00	.00	.45	.20	.01	.00	.01	.00	-.12	.02	.21	.04	-.01	.00	-.03	.00	.06	.00	.61
Sentence Writing Fluency (Grw/Gs)	.61	.37	-.09	.01	.43	.19	.21	.04	.04	.00	-.05	.00	.04	.00	.00	.00	.00	.00	.10	.01	.62
Writing Samples (Grw)	.57	.32	-.03	.00	.03	.00	.53	.28	-.09	.01	.03	.00	.09	.01	.27	.07	-.02	.00	-.06	.00	.70
Word Attack (Grw/Glr)	.64	.41	.00	.00	-.09	.01	.50	.25	-.09	.01	.13	.02	-.03	.00	-.01	.00	.08	.01	.04	.00	.70
Letter-Word Identification (Grw)	.71	.51	.16	.02	.09	.01	.50	.25	-.03	.00	-.01	.00	-.04	.00	-.02	.00	-.02	.00	.00	.00	.79
Passage Comprehension (Grw/Glr)	.72	.52	.17	.03	.05	.00	.43	.18	-.08	.01	.09	.01	.02	.00	.13	.02	-.01	.00	.05	.00	.77
Reading Recall (Grw/Glr)	.48	.23	-.12	.01	.01	.00	.43	.18	-.04	.00	-.06	.00	.21	.04	.15	.02	.06	.00	.47	.22	.72
Spelling (Grw)	.75	.56	.14	.02	.16	.02	.26	.07	.12	.02	-.04	.00	.00	.00	-.07	.00	-.13	.02	-.03	.00	.71
Oral Reading (Grw)	.65	.43	.14	.02	.12	.01	.24	.06	.04	.00	.16	.02	-.11	.01	-.10	.01	-.33	.11	.12	.01	.68
Sound Awareness (Grw/Ga)	.63	.40	-.02	.00	-.01	.00	.23	.05	.11	.01	.23	.05	.05	.00	.02	.00	.03	.00	.12	.01	.53
Verbal Attention (Gwm)	.63	.39	.01	.00	.00	.00	.00	.00	.44	.20	-.12	.01	.07	.00	-.02	.00	-.03	.00	-.15	.02	.63
Nonword Repetition (Ga)	.50	.25	-.06	.00	-.09	.01	.05	.00	.43	.18	.09	.01	-.11	.01	.11	.01	-.01	.00	.06	.00	.49
Sentence Repetition (Gwm)	.58	.33	.09	.01	-.06	.00	.09	.01	.40	.16	-.11	.01	-.07	.01	.01	.00	.19	.03	.14	.02	.58
Memory for Words (Aud Mem)	.54	.29	-.01	.00	-.01	.00	-.07	.01	.39	.15	.11	.01	-.05	.00	.10	.01	.08	.01	-.10	.01	.49
Object-Number Sequencing (Gwm)	.61	.37	.01	.00	.19	.04	-.21	.04	.31	.09	.05	.00	.10	.01	.15	.02	.12	.01	-.02	.00	.60
Understanding Directions (Gwm)	.56	.31	-.05	.00	-.04	.00	.09	.01	.25	.06	-.01	.00	.15	.02	.17	.03	.18	.03	.23	.05	.52
Numbers Reversed (Gwm)	.60	.36	.02	.00	.11	.01	-.02	.00	.19	.04	.11	.01	.12	.01	.03	.00	-.11	.01	-.13	.02	.47
Editing (Grw)	.76	.57	.17	.03	.09	.01	.19	.04	.18	.03	-.12	.02	.10	.01	-.13	.02	-.18	.03	-.10	.01	.76
Sound Blending (Ga)	.51	.26	.08	.01	-.04	.00	.00	.00	.03	.00	.51	.26	-.04	.00	-.05	.00	-.06	.00	-.06	.00	.54
Segmentation (Ga)	.53	.28	-.05	.00	-.07	.01	.24	.06	.00	.00	.49	.24	-.01	.00	.08	.01	.04	.00	-.16	.02	.61
Visual-Auditory Learning (Glr)	.41	.17	.05	.00	-.01	.00	-.01	.00	-.07	.01	.45	.20	.01	.00	.17	.03	.04	.00	.20	.04	.45
Spelling of Sounds (Ga/Grw)	.66	.44	-.12	.01	.05	.00	.29	.08	.05	.00	.39	.15	.08	.01	-.19	.04	-.06	.00	.03	.00	.74
Phonological Processing (Ga)	.69	.47	.10	.01	.05	.00	.10	.01	.08	.01	.30	.09	.06	.00	-.24	.06	.19	.04	-.02	.00	.69
Visualization (Gv)	.53	.28	.01	.00	-.01	.00	.00	.00	.06	.00	.26	.07	.13	.02	.29	.09	-.16	.02	.10	.01	.49
Number Series (Gf)	.67	.45	-.08	.01	-.02	.00	.25	.06	-.04	.00	-.06	.00	.60	.36	-.09	.01	-.06	.00	.15	.02	.92
Calculation (Gq/Gs)	.72	.51	.04	.00	.16	.03	.10	.01	-.07	.01	.00	.00	.47	.22	-.07	.01	-.14	.02	.04	.00	.80
Number Matrices (Gf)	.64	.41	.08	.01	.02	.00	-.06	.00	.06	.00	.05	.00	.45	.20	-.24	.06	.00	.00	.08	.01	.69
Applied Problems (Gq)	.75	.56	.20	.04	.07	.00	.00	.00	-.05	.00	.06	.00	.39	.15	-.01	.00	-.14	.02	.07	.00	.78
Concept Formation (Gf)	.56	.32	.01	.00	-.02	.00	-.03	.00	-.02	.00	.29	.08	.31	.09	.07	.00	.14	.02	.37	.14	.66
Analysis-Synthesis (Gf)	.52	.27	.06	.00	.05	.00	-.11	.01	-.01	.00	.18	.03	.30	.09	.22	.05	.00	.00	-.04	.00	.46
Picture Recognition (Gv)	.26	.07	.04	.00	.05	.00	.12	.01	.06	.00	.05	.00	-.18	.03	.69	.47	.20	.04	.06	.00	.64
Story Recall (Glr)	.50	.25	.12	.01	-.08	.01	.05	.00	.10	.01	-.05	.00	.18	.03	.45	.20	-.07	.01	.02	.00	.52

Table 5 (continued)

Subtest	Second-order factor		First-order factors																		h^2
	g	S^2	F1	S^2	F2	S^2	F3	S^2	F4	S^2	F5	S^2	F6	S^2	F7	S^2	F8	S^2	F9	S^2	
Rapid Picture Naming (Gs/Glr)	.37	.13	.05	.00	.27	.07	.00	.00	.09	.01	.01	.00	-.12	.01	.15	.02	.55	.31	.10	.01	.57
Retrieval Fluency (Glr/Gs)	.49	.24	.17	.03	.25	.06	-.05	.00	.03	.00	.01	.00	.02	.00	.07	.00	.41	.17	-.04	.00	.51
Common variance (%)	55.6			6.5		7.8		6.1		3.4		4.5		5.0		4.4		3.9		2.9	66.1
Total variance (%)	36.8			4.3		5.1		4.0		2.2		3.0		3.3		2.9		2.6		1.9	

Note. g = general intelligence factor; S^2 = variance explained; h^2 = communality. Loadings $\geq .30$ are bolded (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective Cattell-Horn-Carroll theory Stratum I or II factors posited in the Woodcock-Johnson (fourth edition) Technical Manual is indicated following each subtest name.

factor for either age group. For ages 14 to 19, Retrieval Fluency and Rapid Picture Naming formed what appears to be a second Gs factor on the eighth factor.

When further reviewing the pattern of subtest loadings for the nine-factor solution, it was noted that several subtests for ages 9 to 13 aligned with, but failed to saliently load on, their respective group factors (e.g., Sound Awareness, .25 on Grw; Rapid Picture Naming, .29 on Gs), while still others did not display a salient loading or alignment with any group factor (e.g., Numbers Reversed; Story Recall). When reviewing the loadings for ages 14 to 19, several subtests aligned with, but failed to saliently load on, theoretically posited factors (e.g., Spelling, Oral Reading and Sound Awareness, .26, .24 and .23, respectively, on Grw; Understanding Directions and Numbers Reversed, .25 and .19, respectively, on Gwm), while other indicators did not display a salient loading or alignment with theoretically posited factors once the variance from the general factor was residualized (e.g., Visualization; Editing).

Extracting eight factors yielded a similar seven-factor pattern for ages 9 to 13 as the nine-factor extraction (see Tables A5 to A8); however, for ages 14 to 19 an eight-factor extraction yielded six factors with the seventh having limited theoretical meaningfulness and the eighth being trivial (see Tables A5 to A8). Thus, the nine-factor solution was deemed more interpretable as it produced seven CHC-like factors.

Generally, extraction of seven factors as suggested by MAP and PA resulted in a solution that was less consistent with the theoretical structure posited in the *Technical Manual*. Although a seven-factor extraction did not produce trivial factors (i.e., less than two subtests with salient loadings on a factor) as observed with the nine factor extraction, interpretability was deemed inferior. As a result, only five theoretically plausible factors could be identified across both age ranges when seven factors were extracted. Given that it may be better to overextract than underextract (Velicer, Eaton, & Fava, 2000) and considering that factorial consistency across both age groups and that linkage to theory was improved with a nine-factor extraction (resulting in seven plausible CHC factors), this was the solution that was deemed most appropriate.

When compared with Dombrowski and Watkins' (2013) EFA-SL analysis of the WJ III full test battery the results of this study indicate that the WJ IV full test battery more fully aligns with CHC theory. Dombrowski and Watkins' (2013) analyses of the WJ III full test battery (Woodcock, McGrew, & Mather, 2001) revealed Heywood cases (e.g., communalities >1.0), impermissible factors (e.g., no salient loading or only one loading on a factor), and a general lack of convergence of the full test battery's structure. Dombrowski and Watkins (2013) found that the WJ III full test battery did not reflect nine CHC factors as proposed in the *Technical Manual*. Instead, the instrument was deemed to measure six factors at ages 9 to 13 (Gc, Grw, Gs, combined Gf/Gq, Ga, and Glr) and five factors at ages 14 to 19 (Gc, Ga, Gs, Gq, and Glr). More specifically, the academic fluency subtests displayed greater alignment with the Gs factor than with their respective academic factors. This is consistent with the present analysis. At ages 9 to 13 the Gq and Gf subtests fused together to form a combined factor consistent with the present analysis. Only the Gq factor, and not a Gf factor, was identified for ages 14 to 19. The Gc and Grw subtests often cross-loaded higher on alternate factors, and the Gsm and Ga factors did not reflect the subtest content proposed by the authors. These results raised concerns about the structural

Table 6

Summary of Age 9 to 13 Nine-Factor Schmid-Leiman Analysis Subtest Loadings

F1 = Grw	All Grw subtests listed in Technical Manual plus Number Series (Gf), (.31 on Grw; .45 on Gf/Gq)	Cross loadings: Oral Reading (Grw), (.35 on Grw; .49 on F9) Sent Writ Fluency (Grw/Gs), (.32 on Grw; .32 on Gs) Reading Vocabulary (Grw/Gc), (.36 with Gc; .32 with Grw) Word Reading Fluency (Grw/Gs), (.25 with Grw) (.50 with Gs) Sound Awareness (Grw/Ga), (.29 with Ga; .25 w Grw; .29 with Gv) Sentence Reading Fluency (.25 with Grw), (.40 with Gs) Spelling of Sounds (Ga/Grw), (.26 with Grw; .39 with Ga) Number Series (Gf), (.31 on Grw; .45 on Gf/Gq)
F2 = Gc	All Gc subtests plus Reading Vocabulary (Grw/Gc), (.32 on Grw; .36 on Gc)	Gen Infor (Gc, .32 on F9) Reading Vocabulary (grw/Gc), (.36 with Gc; .32 with Grw)
F3 = Gs	Gs subtests plus Sent Writ Fluency (Grw/Gs), (.32 on Grw; .32 on Gs) Word Reading Fluency (Grw/Gs), (.25 with Grw), (.50 with Gs) Sentence Reading Fluency (.25 with Grw), (.40 with Gs) Math Fact Fluency (Gq/Gs), (.42 on Gs; No salient/alignment with Gq) Rapid Picture Naming (Gs/Glr), (.29 on Gs; .21 on F8)	Sentence Writing Fluency (Grw/Gs), (.30 with Grw; .32 with Gs) Word Reading Fluency (Grw/Gs), (.25 with Grw) (.50 with Gs) Sentence Reading Fluency (.25 with Grw), (.40 with Gs)
F4 = Gwm	All Gwm subtests except Numbers Reverse (Gwm), (.15 with Gwm; no salient/alignment on any factor) plus Nonword Repetition (Ga), (.44 on Gwm; no salient/alignment with Ga)	
F5 = Gf/Gq combined factor	All Gf/Gq subtests except Math Fact Fluency (Gq/Gs), (.42 on Gs; no salient/alignment with Gq)	
F6 = Ga	All Ga subtest except Nonword Repetition (Ga), (.44 with Gwm; no alignment/salient with Ga) plus Vis Auditory Learning (Glr), (.35 with Ga; .28 with Gv) Sound Awareness (Grw/Ga), (.25 with Grw; .29 with Ga)	Sound Awareness (Grw/Ga), (.25 with Grw; .29 with Ga) Phon Process (Ga), (.43 on Ga; .31 on F9)
F7 = Gv	All Gv Subtests (two of them)	Vis Auditory Learning (Glr), (.35 with Ga; .28 with Gv) Sound Awareness (Grw/Ga), (.29 with Ga; .25 w Grw; .29 with Gv)

Note: With subtests that have two CHC abilities listed in the WJ IV Technical Manual (i.e., Grw/Gs) the SL results from this study suggest cross loading in many (but not all) cases.

Table 6 (continued)

F8 = ?	Retrieval Fluency (Glr/Gs), (.53) Phon Process (Ga), (.43 on Ga; .31 on F9)
F9 = ?	Oral Read (Grw); Gen Info (Gc) Story Recall (Glr), (.20 on Gf/Gq; .29 on F9)

Note. Subtests with neither alignment nor salient loading on a factor: Story Recall; Numbers Reversed.

validity of the WJ III full test battery and its alignment with existing and later formulations of CHC theory (e.g., [Schneider & McGrew, 2012](#)). Subsequent research on the WJ III Cognitive and WJ III Achievement also found divergent factor structures from those proposed in the *Technical Manual* (e.g., [Dombrowski, 2013, 2014a, 2014b, 2015b](#)).

The results of this present study indicate that more factors appear to be measured by the WJ IV than its third edition counterpart. However, these results also suggest that the patterning of CHC-related variables on the WJ IV may be more complex than is presently described in much of the technical and professional literature.

Limitations and Future Directions

The present study is not without limitations. Most notably the use of correlation matrices produced from the *Technical Manual's* normative sample as a target for EFA analyses is a limitation. Although the current sample served as the normative reference for suggested WJ IV clinical interpretation, additional research is needed to determine if these results generalize to specific clinical populations such as those referred for specific learning disability evaluations and other related neurological impairments. Additionally, independent studies should also examine the structure of

Table 7

Summary of Age 14 to 19 Nine-Factor Schmid-Leiman Analysis Subtest Loadings

F1 = Gc <i>Note:</i> With subtests that have two CHC abilities listed in the WJ IV Technical Manual (i.e., Grw/Gs) the SL results from this study suggest cross loading in many (but not all) cases.	All Gc subtests plus Read Vocabulary (Grw/Gc, .38)	
F2 = Gs	All Gs subtest plus Math Fact Fluency (Gq/Gs), (.45) Word Read Fluency (Grw/Gs, .65) Sentence Read Fluency (Grw/Gs, .50) Sentence Writing Fluency (Grw/Gs, .43)	
F3 = Grw	All Grw subtest except Editing (.19),	Cross loading on Gs: Word Reading Fluency (Grw/Gs, .65) Sentence Reading Fluency (Grw/Gs, .50) Sentence Writing Fluency (Grw/Gs, .43)
F4 = Gwm	All Gwm subtests except Numbers Reversed (.19) Plus Nonword Repetition (Ga), (.43 on Gwm)	
F5 = Ga	All Ga subtests except Nonword Repetition plus Visual Auditory Learning (Glr), (.45)	
F6-Gf/Gq Combined Factor	All Gf/Gq subtests except Math Fact Fluency (Gq/Gs), (.45 with Gs)	Concept Formation (.37 with F9) Math Fact Fluency (Gq/Gs), (.45 with Gs)
F7 = Gv	Pic Recog (Gv, .69), Story Recall (Glr, .45), and Visualization (Gv, .29)	
F8 = Second Gs???	Rapid Pic Naming (Gs/Glr, .55) Retrieval Fluency (Glr/Gs, .41)	
F9 = ???	Reading Recall (Grw/Glr, .47) Concept Formation (Gf, .37)	

Note. Subtests with neither alignment nor salient loading on a factor: Numbers Reversed.

separate WJ IV tests of cognitive ability, achievement, and oral language to determine whether the structure of those instruments is consistent with that delineated in the *Technical Manual* as it is anticipated that most school psychologists will elect to employ large portions of the individual batteries in isolation.

Conclusion and Implications for Practice

The results of this study provided evidence that the WJ IV total battery is a strong measure of *g* and seven smaller CHC factors (Gc, Ga, Gwm, Gv, Grw, Gs, and combined Gf/Gq). However, the subtest composition of many of the factors is different than what is posited in the *Technical Manual*. Results also indicated that the general intelligence factor accounts for anywhere from 6 to 18 times more variance than the lower order CHC factors. To help understand this point, it may be useful to think metaphorically of the gravitational forces that influence the earth within our solar system. Certainly the moon and other planets exert a gravitational influence but it is smaller in size compared with the gravitational force exerted by the sun. It is the same with the general factor and the remaining CHC factors within this study. The lower order factors are indeed present but their influence may be less influential in comparison to that of the general factor.

What do the totality of findings mean for interpretation of the WJ IV battery of tests? The nominal lower-order factor explained common and total variance, the lack of alignment of subtests with theoretically posited factors, the inability to locate several CHC factors (i.e., Gf, Gq, Gltr), and the high degree of cross-loading of subtests on different factors impacts the utility of the WJ IV for direct index level interpretation, cross-battery assessment, and other related interpretive procedures such as pattern of strengths and weaknesses (PSW) analyses (e.g., Flanagan, Alfonso, & Mascolo, 2011; Flanagan, Ortiz, & Alfonso, 2013; Niileksela, Reynolds, Keith, & McGrew, 2016). The factors undergirding these approaches may be ephemeral, may lack sufficient unique variance for confident interpretation, and may reflect a different subtest composition from what is suggested in the *Technical Manual*. If a factor is nonexistent or complexly determined, or if a subtest proposed to measure Grw instead measures Gs then the foundation for using either that factor or that subtest is simply not sufficiently strong for an interpretive heuristic such as cross-battery assessment (XBA) or PSW or even for straightforward CHC index level interpretation. For example, Flanagan et al. (2013) have proposed a model for specific learning disability (SLD) identification which encourages practitioners to interpret group-factor scores as unidimensional indicators of cognitive-achievement abilities. The present results suggest that these practices may be difficult for practitioners to employ with confidence for several of the CHC-related indicators from the WJ IV.

Although the present results suggest that the WJ IV has many laudable features, researchers and practitioners are encouraged to understand more fully the implications of the evidence offered by this study when interpreting the WJ IV CHC-related indices, and when engaging in complex diagnostic procedures such as XBA and PSW via the WJ IV (i.e., Kranzler et al., 2016; McGill, 2015, 2017; McGill & Busse, 2015, 2017).

References

- Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Psychology*, 3, 77–85.
- Bartlett, M. S. (1954). A further note on the multiplying factors for various X^2 approximations in factor analysis. *Journal of the Royal Statistical Society Series A (General)*, 16, 296–298.
- Bentler, P. M., & Kano, Y. (1990). On the equivalence of factors and components. *Multivariate Behavioral Research*, 25, 67–74. http://dx.doi.org/10.1207/s15327906mbr2501_8
- Canivez, G. L. (2016). Bifactor modeling in construct validation of multifactor tests: Implications for understanding multidimensional constructs and test interpretation. In K. Schweizer & C. DiStefano (Eds.), *Principles and methods of test construction: Standards and recent advancements* (pp. 247–271). Gottingen, Germany: Hogrefe.
- Canivez, G. L. (2017). Review of the Woodcock–Johnson IV. In J. F. Carlson, K. F. Geisinger, & J. L. Jonson (Eds.), *The twentieth mental measurements yearbook*. Lincoln, NE: Buros Center for Testing. Available for download at <http://marketplace.unl.edu/buros/>
- Carretta, T. R., & Ree, J. J. (2001). Pitfalls of ability research. *International Journal of Selection and Assessment*, 9, 325–335. <http://dx.doi.org/10.1111/1468-2389.00184>
- Carroll, J. B. (1993). *Human cognitive abilities*. Cambridge, UK: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511571312>
- Carroll, J. B. (1995). On methodology in the study of cognitive abilities. *Multivariate Behavioral Research*, 30, 429–452. http://dx.doi.org/10.1207/s15327906mbr3003_6
- Carroll, J. B. (1997). The three-stratum theory of cognitive abilities. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 183–208). New York, NY: Guilford Press.
- Carroll, J. B. (2003). The higher-stratum structure of cognitive abilities: Current evidence supports *g* and about ten broad factors. In H. Nyborg (Ed.), *The scientific study of general intelligence: Tribute to Arthur R. Jensen* (pp. 5–21). New York, NY: Pergamon Press. <http://dx.doi.org/10.1016/B978-008043793-4/50036-2>
- Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research*, 1, 245–276. http://dx.doi.org/10.1207/s15327906mbr0102_10
- Child, D. (2006). *The essentials of factor analysis* (2nd ed.). New York, NY: Continuum.
- Cudeck, R. (2000). Exploratory factor analysis. In H. E. A. Tinsley & S. D. Brown (Eds.), *Handbook of multivariate statistics and mathematical modeling* (pp. 265–296). New York, NY: Academic Press. <http://dx.doi.org/10.1016/B978-012691360-6/50011-2>
- DiStefano, C. & Dombrowski, S. C. (2006). Investigating the theoretical structure of the Stanford-Binet, Fifth Edition. *Journal of Psychoeducational Assessment*, 24, 123–136. <http://dx.doi.org/10.1177/0734282905285244>
- Dombrowski, S. C. (2013). Investigating the structure of the WJ-III Cognitive at school age. *School Psychology Quarterly*, 28, 154–169. <http://dx.doi.org/10.1037/spq0000010>
- Dombrowski, S. C. (2014a). Exploratory bifactor analysis of the WJ-III Cognitive in adulthood via the Schmid–Leiman procedure. *Journal of Psychoeducational Assessment*, 32, 330–341. <http://dx.doi.org/10.1177/0734282913508243>
- Dombrowski, S. C. (2014b). Investigating the structure of the WJ-III Cognitive in early school age through two exploratory bifactor analysis procedures. *Journal of Psychoeducational Assessment*, 32, 483–494. <http://dx.doi.org/10.1177/0734282914530838>
- Dombrowski, S. C. (2015a). *Psychoeducational assessment and reporting*. New York, NY: Springer Science.
- Dombrowski, S. C. (2015b). Exploratory bifactor analysis of the WJ-III Achievement at school age via the Schmid–Leiman orthogonalization procedure. *Canadian Journal of School Psychology*, 30, 34–50. <http://dx.doi.org/10.1177/0829573514560529>
- Dombrowski, S. C., Canivez, G. L., & Watkins, M. W. (2017). Factor structure of the 10 WISC–V primary subtests in four standardization age

- groups. *Contemporary School Psychology*. Advance online publication. <http://dx.doi.org/10.1007/s40688-017-0125-2>
- Dombrowski, S. C., Canivez, G. L., Watkins, M. W., & Beaujean, A. A. (2015). Exploratory bifactor analysis of the Wechsler Intelligence Scale for Children—Fifth Edition with the 16 primary and secondary subtests. *Intelligence*, 53, 194–201. <http://dx.doi.org/10.1016/j.intell.2015.10.009>
- Dombrowski, S. C., McGill, R. J., & Canivez, G. L. (2017). Exploratory and hierarchical factor analysis of the WJ IV Cognitive at school age. *Psychological Assessment*, 29, 394–407.
- Dombrowski, S. C., & Watkins, M. W. (2013). Exploratory and higher order factor analysis of the WJ-III full test battery: A school-aged analysis. *Psychological Assessment*, 25, 442–455. <http://dx.doi.org/10.1037/a0031335>
- Fabrigar, L. R., & Wegener, D. T. (2012). *Exploratory factor analysis*. New York, NY: Oxford University Press.
- Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, 4, 272–299. <http://dx.doi.org/10.1037/1082-989X.4.3.272>
- Flanagan, D. P., Alfonso, V. C., & Mascolo, J. T. (2011). A CHC-based operational definition of SLD: Integrating multiple data sources and multiple data-gathering methods. In D. P. Flanagan & V. C. Alfonso (Eds.), *Essentials of specific learning disability identification* (pp. 233–298). Hoboken, NJ: Wiley.
- Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2013). *Essentials of cross-battery assessment* (3rd ed.). Hoboken, NJ: Wiley.
- Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, 30, 179–185. <http://dx.doi.org/10.1007/BF02289447>
- Horn, J. L., & Cattell, R. B. (1966). Refinement and test of the theory of fluid and crystallized general intelligences. *Journal of Educational Psychology*, 57, 253–270. <http://dx.doi.org/10.1037/h0023816>
- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31–36. <http://dx.doi.org/10.1007/BF02291575>
- Keith, T. Z., & Reynolds, M. R. (2010). CHC and cognitive abilities: What we've learned from 20 years of research. *Psychology in the Schools*, 47, 635–650.
- Kline, P. (1994). *An easy guide to factor analysis*. New York, NY: Routledge.
- Kranzler, J. H., Floyd, R. G., Benson, N., Zaboiski, B., & Thibodaux, L. (2016). Cross-battery assessment pattern of strengths and weaknesses approach to the identification of specific learning disorders: Evidence-based practice or pseudoscience? *International Journal of School & Educational Psychology*, 4, 146–157. <http://dx.doi.org/10.1080/21683603.2016.1192855>
- McClain, A. L. (1996). Hierarchical analytic methods that yield different perspectives on dynamics: Aids to interpretation. *Advances in Social Science Methodology*, 4, 229–240.
- McGill, R. J. (2015). Incremental criterion validity of the WJ-III COG clinical clusters: Marginal predictive effects beyond the general factor. *Canadian Journal of School Psychology*, 30, 51–63. <http://dx.doi.org/10.1177/0829573514553926>
- McGill, R. J. (2017). Re(examining) relations between CHC broad and narrow cognitive abilities and reading achievement. *Journal of Educational and Developmental Psychology*, 7, 265–282. <http://dx.doi.org/10.5539/jedp.v7n1p265>
- McGill, R. J., & Busse, R. T. (2015). Incremental validity of the WJ III COG: Limited predictive effects beyond the GIA-E. *School Psychology Quarterly*, 30, 353–365. <http://dx.doi.org/10.1037/spq0000094>
- McGill, R. J., & Busse, R. T. (2017). When theory trumps science: A critique of the PSW model for SLD identification. *Contemporary School Psychology*, 21, 10–18. <http://dx.doi.org/10.1007/s40688-016-0094-x>
- McGrew, K. S., LaForte, E. M., & Schrank, F. A. (2014). *Technical manual: Woodcock-Johnson IV*. Rolling Meadows, IL: Riverside.
- Niileksela, C. R., Reynolds, M. R., Keith, T. Z., & McGrew, K. S. (2016). A special validity study of the WJ IV: Acting on evidence for specific abilities. In D. P. Flanagan & V. C. Alfonso (Eds.), *WJ IV clinical use and interpretation: Scientist-Practitioner perspectives* (pp. 65–106). New York, NY: Academic Press. <http://dx.doi.org/10.1016/B978-0-12-802076-0.00003-7>
- O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments & Computers*, 32, 396–402. <http://dx.doi.org/10.3758/BF03200807>
- Osborne, J. W. (2015). What is rotating in exploratory factor analysis? *Practical Assessment, Research & Evaluation*, 20. Retrieved from <http://pareonline.net/getvn.asp?v=20&n=2>
- Preacher, K. J., & MacCallum, R. C. (2003). Repairing Tom Swift's electric factor analysis machine. *Understanding Statistics*, 2, 13–43. http://dx.doi.org/10.1207/S15328031US0201_02
- Ree, M. J., Carretta, T. R., & Green, M. T. (2003). The ubiquitous role of g in training. In H. Nyborg (Ed.), *The scientific study of general intelligence: Tribute to Arthur R. Jensen* (pp. 261–274). New York, NY: Pergamon Press. <http://dx.doi.org/10.1016/B978-008043793-4/50051-9>
- Schmid, J., & Leiman, J. M. (1957). The development of hierarchical factor solutions. *Psychometrika*, 22, 53–61. <http://dx.doi.org/10.1007/BF02289209>
- Schmitt, T. A. (2011). Current methodological considerations in exploratory and confirmatory factor analysis. *Journal of Psychoeducational Assessment*, 29, 304–321. <http://dx.doi.org/10.1177/0734282911406653>
- Schneider, W. J., & McGrew, K. S. (2012). The Cattell-Horn-Carroll model of intelligence. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (3rd ed., pp. 99–144). New York, NY: Guilford Press.
- Schrank, F., Decker, S. L., & Garruto, J. M. (2016). *Essentials of WJ IV cognitive ability assessment*. New York, NY: Wiley and Sons.
- Schrank, F. A., Mather, N., & McGrew, K. S. (2014a). *Woodcock-Johnson IV Tests of Achievement*. Rolling Meadows, IL: Riverside.
- Schrank, F. A., Mather, N., & McGrew, K. S. (2014b). *Woodcock-Johnson IV Tests of Oral Language*. Rolling Meadows, IL: Riverside.
- Schrank, F. A., McGrew, K. S., & Mather, N. (2014a). *Woodcock-Johnson IV*. Rolling Meadows, IL: Riverside.
- Schrank, F. A., McGrew, K. S., & Mather, N. (2014b). *Woodcock-Johnson IV Tests of Cognitive Abilities*. Rolling Meadows, IL: Riverside.
- Sotelo-Dynega, M., & Dixon, S. G. (2014). Cognitive assessment practices: A survey of school psychologists. *Psychology in the Schools*, 51, 1031–1045.
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson Education.
- Tataryn, D. J., Wood, J. M., & Gorsuch, R. L. (1999). Setting the value of k in promax: A Monte Carlo study. *Educational and Psychological Measurement*, 59, 384–391. <http://dx.doi.org/10.1177/00131649921969938>
- Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. Washington, DC: American Psychological Association. <http://dx.doi.org/10.1037/10694-000>
- Thurstone, L. L. (1947). *Multiple-factor analysis*. Chicago, IL: University of Chicago Press.
- Tusing, M. E., & Ford, L. (2004). Examining preschool cognitive abilities using a CHC framework. *International Journal of Testing*, 4, 91–114.
- Velicer, W. F. (1976). Determining the number of components form the matrix of partial correlations. *Psychometrika*, 41, 321–327. <http://dx.doi.org/10.1007/BF02293557>
- Velicer, W. F., Eaton, C. A., & Fava, J. L. (2000). Construct explication through factor or component analysis: A view and evaluation of alternative procedures for determining the number of factors or components. In R. D. Goffin & E. Helmes (Eds.), *Problems and solutions in human assessment: A festschrift to Douglas Jackson at seventy* (pp. 41–71). Norwell, MA: Kluwer Academic. http://dx.doi.org/10.1007/978-1-4615-4397-8_3

Widaman, K. F. (1993). Common factor analysis versus principal component analysis: Differential bias in representing model parameters? *Multivariate Behavioral Research*, 28, 263–311. http://dx.doi.org/10.1207/s15327906mbr2803_1

Wolff, H.-G., & Preising, K. (2005). Exploring item and higher order factor structure with the Schmid-Leiman solution: Syntax codes for SPSS and SAS. *Behavior Research Methods*, 37, 48–58. <http://dx.doi.org/10.3758/BF03206397>

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III*. Itasca, IL: Riverside.

Received November 16, 2016
Revision received June 12, 2017
Accepted June 14, 2017 ■

Members of Underrepresented Groups: Reviewers for Journal Manuscripts Wanted

If you are interested in reviewing manuscripts for APA journals, the APA Publications and Communications Board would like to invite your participation. Manuscript reviewers are vital to the publications process. As a reviewer, you would gain valuable experience in publishing. The P&C Board is particularly interested in encouraging members of underrepresented groups to participate more in this process.

If you are interested in reviewing manuscripts, please write APA Journals at Reviewers@apa.org. Please note the following important points:

- To be selected as a reviewer, you must have published articles in peer-reviewed journals. The experience of publishing provides a reviewer with the basis for preparing a thorough, objective review.
- To be selected, it is critical to be a regular reader of the five to six empirical journals that are most central to the area or journal for which you would like to review. Current knowledge of recently published research provides a reviewer with the knowledge base to evaluate a new submission within the context of existing research.
- To select the appropriate reviewers for each manuscript, the editor needs detailed information. Please include with your letter your vita. In the letter, please identify which APA journal(s) you are interested in, and describe your area of expertise. Be as specific as possible. For example, “social psychology” is not sufficient—you would need to specify “social cognition” or “attitude change” as well.
- Reviewing a manuscript takes time (1–4 hours per manuscript reviewed). If you are selected to review a manuscript, be prepared to invest the necessary time to evaluate the manuscript thoroughly.

APA now has an online video course that provides guidance in reviewing manuscripts. To learn more about the course and to access the video, visit <http://www.apa.org/pubs/authors/review-manuscript-ce-video.aspx>.

Supplemental Materials

Hierarchical Exploratory Factor Analyses of the Woodcock-Johnson IV Full Test Battery: Implications for CHC Application in School Psychology

by S. C. Dombrowski et al., 2018, *School Psychology Quarterly*

<http://dx.doi.org/10.1037/spq0000221>

Table A1

Age 9- to 13- WJ-IV Principal Axis Factor with Promax Rotation (Seven Factors)

Subtest	Pattern (Structure Coefficients)							h^2	u^2
	I	II	III	IV	V	VI	VII		
Letter-Word Identification (Grw)	.79 (.88)	.17 (.61)	.04 (.55)	-.12 (.31)	-.01 (.43)	.05 (.44)	.02 (-.04)	.80	.20
Word Attack (Grw/Glr)	.77 (.76)	-.06 (.45)	-.16 (.36)	.03 (.39)	.26 (.52)	-.03 (.35)	.07 (.00)	.63	.37
Writing Samples (Grw)	.75 (.66)	-.17 (.32)	-.04 (.40)	-.06 (.21)	-.06 (.31)	.27 (.49)	.25 (.22)	.58	.42
Passage Comprehension (Grw/Glr)	.72 (.80)	.19 (.60)	-.05 (.48)	.05 (.38)	-.08 (.42)	.07 (.46)	.18 (.11)	.70	.30
Reading Recall (Grw/Glr)	.63 (.64)	-.11 (.35)	.02 (.43)	-.05 (.24)	-.04 (.32)	.26 (.48)	.12 (.11)	.48	.52
Oral Reading (Grw)	.59 (.78)	.26 (.57)	.15 (.53)	.17 (.48)	-.11 (.33)	-.21 (.19)	-.14 (-.27)	.72	.28
Spelling (Grw)	.58 (.82)	.15 (.61)	.21 (.64)	-.06 (.39)	.12 (.50)	.02 (.43)	-.09 (-.12)	.74	.26
Spelling of Sounds (Ga/Grw)	.52 (.68)	-.19 (.36)	-.05 (.40)	.30 (.60)	.22 (.50)	.10 (.36)	-.20 (-.25)	.64	.36
Editing (Grw)	.47 (.77)	.24 (.65)	.13 (.58)	-.12 (.36)	.15 (.53)	.12 (.47)	-.19 (-.16)	.72	.28
Sound Awareness (Grw/Ga)	.46 (.63)	-.09 (.41)	-.02 (.40)	.28 (.55)	.26 (.55)	-.01 (.36)	.04 (-.02)	.53	.47
General Information (Gc)	-.03 (.43)	.90 (.80)	.05 (.37)	.20 (.40)	-.19 (.33)	-.16 (.24)	.04 (.01)	.69	.31
Picture Vocabulary (Gc)	.00 (.44)	.89 (.85)	-.07 (.33)	-.05 (.27)	.05 (.48)	-.03 (.37)	.08 (.14)	.74	.26
Social Studies (Gc)	-.01 (.46)	.74 (.80)	-.05 (.38)	-.13 (.24)	.02 (.48)	.29 (.56)	-.05 (.09)	.70	.30
Oral Vocabulary (Gc)	.12 (.56)	.71 (.83)	-.02 (.43)	.08 (.41)	.02 (.52)	.05 (.46)	.04 (.08)	.71	.29
Humanities (Gc)	-.12 (.41)	.71 (.77)	-.04 (.35)	.08 (.40)	.11 (.52)	.13 (.44)	-.12 (-.02)	.62	.38
Oral Comprehension (Gc)	.23 (.49)	.60 (.74)	-.16 (.30)	-.02 (.28)	.14 (.54)	-.03 (.42)	.31 (.34)	.67	.33
Reading Vocabulary (Grw/Gc)	.42 (.74)	.52 (.78)	.00 (.50)	.03 (.42)	-.03 (.49)	.05 (.45)	-.03 (-.04)	.74	.26
Science (Gc)	.07 (.43)	.50 (.69)	-.22 (.28)	-.16 (.23)	.20 (.56)	.45 (.64)	-.04 (.14)	.66	.34
Letter-Pattern Matching (Gs)	-.04 (.39)	-.11 (.28)	.81 (.77)	.09 (.31)	-.01 (.29)	.00 (.36)	.09 (.09)	.61	.39
Word Reading Fluency (Grw/Gs)	.13 (.56)	.07 (.45)	.80 (.84)	-.12 (.24)	.03 (.34)	-.07 (.35)	-.03 (-.03)	.72	.28
Number-Pattern Matching (PerSpd)	.19 (.47)	-.25 (.24)	.72 (.75)	-.04 (.22)	.00 (.29)	.12 (.44)	.17 (.18)	.64	.36
Pair Cancellation (Gs)	-.25 (.24)	-.01 (.29)	.72 (.65)	-.05 (.20)	.14 (.33)	.09 (.38)	.01 (.10)	.47	.53
Sentence Reading Fluency (Grw/Gs)	.39 (.71)	.08 (.51)	.65 (.82)	-.02 (.34)	-.04 (.37)	-.13 (.36)	.09 (.02)	.78	.22
Math Fact Fluency (Gq/Gs)	.21 (.60)	.04 (.45)	.63 (.78)	-.05 (.29)	-.07 (.33)	.11 (.45)	-.03 (-.02)	.65	.35
Sentence Writing Fluency (Grw/Gs)	.45 (.69)	-.16 (.37)	.56 (.76)	-.04 (.32)	.04 (.37)	.04 (.42)	.02 (-.01)	.68	.32
Numbers Reversed (Gwm)	-.01 (.39)	.05 (.39)	.23 (.46)	.19 (.43)	.19 (.46)	.14 (.41)	-.07 (-.02)	.35	.65
Sound Blending (Ga)	-.01 (.26)	.12 (.31)	-.14 (.14)	.66 (.66)	.09 (.37)	-.10 (.15)	.01 (-.07)	.47	.53
Visual-Auditory Learning (Glr)	-.01 (.24)	.00 (.25)	.01 (.24)	.63 (.59)	-.05 (.31)	.05 (.29)	.23 (.16)	.40	.60
Visualization (Gv)	.04 (.31)	.04 (.34)	.04 (.32)	.56 (.58)	-.05 (.37)	.09 (.38)	.29 (.24)	.45	.55
Segmentation (Ga)	.21 (.37)	-.18 (.24)	-.21 (.17)	.48 (.59)	.27 (.49)	.14 (.35)	.06 (.03)	.46	.54
Concept Formation (Gf)	-.06 (.32)	.09 (.40)	.06 (.37)	.41 (.54)	.03 (.44)	.31 (.53)	.12 (.17)	.45	.55

Memory for Words (Aud Mem)	-.09	(.28)	-.03	(.36)	.00	(.26)	.23	(.49)	.64	(.69)	-.02	(.32)	-.01	(.05)	.51	.49
Verbal Attention (Gwm)	.15	(.45)	-.04	(.43)	.05	(.38)	-.08	(.34)	.63	(.70)	.09	(.43)	-.07	(.03)	.52	.48
Sentence Repetition (Gwm)	.21	(.45)	.16	(.50)	-.02	(.31)	-.14	(.26)	.63	(.67)	-.14	(.29)	.03	(.09)	.51	.49
Nonword Repetition (Ga)	.23	(.40)	-.04	(.35)	-.04	(.25)	.13	(.39)	.57	(.62)	-.21	(.21)	.14	(.12)	.44	.56
Object-Number Sequencing (Gwm)	-.30	(.23)	.04	(.41)	.34	(.48)	.17	(.44)	.52	(.66)	.05	(.44)	.10	(.20)	.56	.44
Phonological Processing (Ga)	.13	(.51)	.03	(.48)	.02	(.41)	.23	(.57)	.44	(.66)	.10	(.42)	-.16	(-.12)	.56	.44
Rapid Picture Naming (Gs/Glr)	-.12	(.22)	.17	(.40)	.37	(.43)	-.13	(.13)	.38	(.48)	-.13	(.29)	.27	(.34)	.42	.58
Understanding Directions (Gwm)	.14	(.40)	.08	(.45)	.02	(.35)	.09	(.36)	.33	(.57)	.10	(.46)	.23	(.28)	.42	.58
Retrieval Fluency (Glr/Gs)	-.15	(.27)	.24	(.47)	.28	(.44)	-.09	(.20)	.28	(.48)	.12	(.43)	.09	(.21)	.37	.63
Number Series (Gf)	.46	(.67)	-.13	(.42)	.02	(.52)	-.02	(.35)	-.08	(.40)	.72	(.79)	-.12	(.00)	.79	.21
Calculation (Gq/Gs)	.29	(.63)	.02	(.48)	.26	(.64)	.05	(.38)	-.19	(.35)	.58	(.72)	-.10	(-.01)	.72	.28
Number Matrices (Gf)	.00	(.45)	.10	(.47)	.12	(.47)	.08	(.41)	.12	(.48)	.50	(.63)	-.26	(-.11)	.53	.47
Applied Problems (Gq)	.13	(.57)	.31	(.62)	.13	(.56)	.21	(.48)	-.23	(.40)	.50	(.71)	.00	(.08)	.69	.31
Analysis-Synthesis (Gf)	-.20	(.24)	.11	(.39)	.10	(.37)	.44	(.52)	-.07	(.39)	.46	(.61)	.13	(.22)	.53	.47
Picture Recognition (Gv)	.09	(.19)	.02	(.25)	.15	(.27)	.32	(.30)	.04	(.31)	-.17	(.24)	.69	(.61)	.54	.46
Story Recall (Glr)	.07	(.30)	.16	(.41)	-.07	(.26)	.12	(.29)	.08	(.42)	.29	(.52)	.31	(.38)	.40	.60
Eigenvalue	18.30		3.18		2.51		2.17		1.65		1.41		1.36			
Variance (%)	38.94		6.78		5.35		4.62		3.52		3.00		2.89			
Factor 1	1.0															
Factor 2	.57	1.0														
Factor 3	.58	.46	1.0													
Factor 4	.43	.39	.36	1.0												
Factor 5	.45	.56	.39	.49	1.0											
Factor 6	.41	.46	.46	.33	.50	1.0										
Factor 7	-.12	.07	.02	-.12	.14	.26	1.0									

Note. h^2 = Communality coefficient. u^2 = Uniqueness. Pattern coefficients $> .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective CHC stratum I or II factors posited in the WJ-IV Technical Manual is indicated following each subtest name.

Table A2

Age 14- to 19- WJ-IV Principal Axis Factor with Promax Rotation (Seven Factors)

Subtest	Pattern (Structure Coefficients)										h^2	u^2
	I	II	III	IV	V	VI	VII					
Picture Vocabulary (Gc)	.93 (.86)	.07 (.51)	-.03 (.42)	-.03 (.53)	.01 (.43)	-.13 (.45)	.12 (.11)	.76	.24			
General Information (Gc)	.90 (.80)	-.03 (.46)	.05 (.42)	-.20 (.42)	.12 (.44)	-.07 (.43)	.01 (.01)	.67	.33			
Social Studies (Gc)	.77 (.83)	-.07 (.49)	-.03 (.46)	.02 (.56)	-.08 (.42)	.26 (.63)	-.03 (.03)	.73	.27			
Humanities (Gc)	.74 (.81)	-.13 (.45)	-.05 (.41)	.11 (.59)	.07 (.49)	.10 (.54)	-.07 (.00)	.67	.33			
Oral Vocabulary (Gc)	.72 (.85)	.09 (.60)	.00 (.50)	.00 (.59)	.08 (.53)	.06 (.58)	.00 (.03)	.74	.26			
Oral Comprehension (Gc)	.70 (.78)	.16 (.52)	-.14 (.36)	.19 (.60)	-.07 (.42)	-.05 (.48)	.19 (.18)	.67	.33			
Reading Vocabulary (Grw/Gc)	.63 (.84)	.39 (.75)	.00 (.52)	-.08 (.55)	.03 (.48)	.02 (.56)	-.02 (-.07)	.79	.21			
Science (Gc)	.56 (.76)	.05 (.52)	-.19 (.38)	.18 (.61)	-.09 (.43)	.35 (.65)	.01 (.07)	.67	.33			
Letter-Word Identification (Grw)	.22 (.67)	.74 (.88)	.05 (.55)	.04 (.54)	-.04 (.41)	-.05 (.50)	-.02 (-.12)	.81	.19			
Reading Recall (Grw/Grl)	-.14 (.34)	.71 (.64)	.02 (.39)	-.11 (.30)	-.06 (.28)	.22 (.48)	.26 (.18)	.51	.49			
Writing Samples (Grw)	-.10 (.43)	.68 (.69)	-.03 (.42)	-.01 (.43)	.03 (.40)	.22 (.54)	.22 (.17)	.56	.44			
Word Attack (Grw/Glrl)	-.02 (.53)	.66 (.74)	-.15 (.37)	.30 (.60)	.14 (.51)	-.06 (.45)	.04 (-.01)	.64	.36			
Passage Comprehension (Grw/Glrl)	.24 (.67)	.63 (.80)	.01 (.53)	-.08 (.52)	.11 (.52)	.06 (.58)	.13 (.07)	.73	.27			
Oral Reading (Grw)	.22 (.60)	.59 (.78)	.15 (.52)	-.13 (.42)	.22 (.47)	-.14 (.40)	-.16 (-.23)	.69	.31			
Spelling (Grw)	.20 (.68)	.49 (.80)	.18 (.62)	.18 (.61)	-.05 (.43)	.01 (.54)	-.12 (-.15)	.74	.26			
Editing (Grw)	.24 (.70)	.37 (.76)	.09 (.58)	.27 (.64)	-.16 (.39)	.18 (.60)	-.20 (-.20)	.75	.25			
Sound Awareness (Grw/Ga)	-.03 (.50)	.36 (.59)	-.01 (.43)	.20 (.58)	.30 (.59)	.04 (.50)	.05 (.08)	.51	.49			
Word Reading Fluency (Grw/Gs)	.12 (.46)	.11 (.51)	.86 (.83)	-.09 (.36)	-.10 (.25)	-.12 (.39)	-.03 (-.04)	.72	.28			
Letter-Pattern Matching (Gs)	-.16 (.33)	.01 (.38)	.76 (.76)	.02 (.41)	.14 (.41)	.00 (.45)	.12 (.18)	.61	.39			
Pair Cancellation (Gs)	.02 (.37)	-.27 (.26)	.70 (.69)	.08 (.41)	.15 (.39)	.04 (.41)	-.09 (.02)	.52	.48			
Number-Pattern Matching (PerSpd)	-.22 (.32)	.15 (.45)	.70 (.74)	.08 (.39)	-.12 (.26)	.16 (.48)	.06 (.10)	.58	.42			
Sentence Reading Fluency (Grw/Gs)	.12 (.55)	.39 (.68)	.67 (.81)	-.09 (.44)	-.05 (.36)	-.12 (.47)	.11 (.05)	.76	.24			
Math Fact Fluency (Gq/Gs)	-.01 (.46)	.15 (.53)	.59 (.74)	-.07 (.39)	-.15 (.28)	.30 (.59)	-.03 (.01)	.62	.38			
Sentence Writing Fluency (Grw/Gs)	-.14 (.43)	.44 (.66)	.56 (.73)	.01 (.43)	-.06 (.33)	.05 (.49)	.01 (-.02)	.65	.35			
Rapid Picture Naming (Gs/Glrl)	.13 (.33)	-.12 (.17)	.37 (.43)	.33 (.45)	.00 (.29)	-.23 (.24)	.31 (.35)	.38	.62			
Retrieval Fluency (Glrl/Gs)	.29 (.49)	-.20 (.25)	.32 (.50)	.23 (.50)	.00 (.36)	.01 (.42)	.15 (.23)	.40	.60			
Verbal Attention (Gwm)	-.01 (.50)	.03 (.44)	.01 (.42)	.77 (.75)	-.16 (.38)	.13 (.49)	-.08 (.02)	.59	.41			
Memory for Words (Aud Mem)	-.03 (.41)	-.11 (.28)	.02 (.34)	.69 (.70)	.15 (.50)	-.04 (.39)	.08 (.19)	.52	.48			
Sentence Repetition (Gwm)	.19 (.54)	.18 (.46)	-.04 (.35)	.68 (.70)	-.15 (.35)	-.16 (.35)	.09 (.10)	.54	.46			
Nonword Repetition (Ga)	-.09 (.36)	.17 (.37)	-.08 (.27)	.65 (.64)	.13 (.45)	-.15 (.30)	.10 (.15)	.45	.55			

Object-Number Sequencing (Gwm)	.02	(.47)	-.26	(.26)	.29	(.55)	.49	(.68)	.09	(.51)	.17	(.56)	.14	(.30)	.60	.40
Understanding Directions (Gwm)	-.04	(.43)	.15	(.40)	-.02	(.38)	.42	(.61)	.00	(.43)	.18	(.52)	.25	(.32)	.46	.54
Numbers Reversed (Gwm)	.00	(.47)	.01	(.42)	.14	(.48)	.28	(.57)	.15	(.50)	.23	(.55)	-.04	(.06)	.42	.58
Sound Blending (Ga)	.13	(.44)	-.02	(.34)	-.05	(.29)	.05	(.47)	.69	(.71)	-.05	(.37)	-.08	(.02)	.52	.48
Visual-Auditory Learning (Glr)	.11	(.35)	.03	(.26)	.02	(.27)	-.19	(.31)	.62	(.62)	.00	(.36)	.21	(.28)	.43	.57
Segmentation (Ga)	-.12	(.38)	.20	(.42)	-.13	(.28)	.17	(.53)	.61	(.71)	.04	(.43)	.06	(.14)	.54	.46
Spelling of Sounds (Ga/Grw)	-.20	(.47)	.42	(.68)	.04	(.48)	.14	(.58)	.51	(.70)	.08	(.52)	-.18	(-.14)	.71	.29
Concept Formation (Gf)	.09	(.47)	.00	(.36)	.03	(.40)	-.07	(.46)	.38	(.61)	.35	(.61)	.17	(.28)	.51	.49
Visualization (Gv)	.00	(.40)	.12	(.37)	.00	(.36)	-.04	(.43)	.38	(.57)	.26	(.54)	.23	(.31)	.45	.55
Phonological Processing (Ga)	.18	(.62)	.05	(.53)	.07	(.49)	.29	(.67)	.37	(.67)	.02	(.52)	-.17	(-.08)	.63	.37
Number Series (Gf)	-.12	(.50)	.34	(.65)	-.05	(.50)	-.02	(.48)	-.08	(.41)	.84	(.85)	-.08	(.01)	.80	.20
Calculation (Gq/Gs)	.06	(.59)	.20	(.64)	.19	(.63)	-.16	(.47)	.01	(.47)	.70	(.83)	-.12	(-.03)	.79	.21
Applied Problems (Gq)	.32	(.70)	.07	(.58)	.09	(.58)	-.17	(.51)	.10	(.54)	.59	(.81)	-.05	(.05)	.76	.24
Number Matrices (Gf)	.16	(.57)	-.09	(.45)	.05	(.48)	.11	(.54)	.06	(.47)	.58	(.71)	-.22	(-.08)	.59	.41
Analysis-Synthesis (Gf)	.08	(.43)	-.19	(.24)	.06	(.40)	-.01	(.44)	.26	(.53)	.50	(.64)	.17	(.33)	.52	.48
Picture Recognition (Gv)	.03	(.20)	.16	(.13)	.06	(.20)	.11	(.29)	.08	(.28)	-.16	(.21)	.70	(.68)	.53	.47
Story Recall (Glr)	.16	(.44)	.11	(.33)	-.10	(.30)	.09	(.44)	-.03	(.36)	.36	(.56)	.37	(.43)	.46	.54
Eigenvalue	19.96		2.78		2.47		1.89		1.65		1.42		1.29			
Variance (%)	42.48		5.92		5.26		4.02		3.51		3.03		2.75			
Factor 1	1.0															
Factor 2	.60	1.0														
Factor 3	.53	.54	1.0													
Factor 4	.64	.52	.51	1.0												
Factor 5	.52	.43	.42	.60	1.0											
Factor 6	.60	.53	.56	.58	.54	1.0										
Factor 7	.02	-.14	.05	.13	.15	.18	1.0									

Note. h^2 = Communality coefficient. u^2 = Uniqueness. Pattern coefficients $> .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective CHC stratum I or II factors posited in the WJ-IV Technical Manual is indicated following each subtest name.

Table A3

WJIV Sources of Variance According to a Schmid-Leiman Orthogonalization (7 Factor) Ages 9 to 13

Subtest	Second-Order Factor			First-Order Factors									
	<i>g</i>	<i>S</i> ²	F1	<i>S</i> ²	F2	<i>S</i> ²	F3	<i>S</i> ²	F4	<i>S</i> ²	F5	<i>S</i> ²	F6
Letter-Word Identification (Grw)	.69	.47	.54	.29	.12	.01	.03	.00	-.10	.01	-.01	.00	.04
Word Attack (Grw/Glr)	.60	.36	.53	.28	-.04	.00	-.12	.01	.02	.00	.18	.03	-.02
Writing Samples (Grw)	.51	.26	.52	.27	-.11	.01	-.03	.00	-.05	.00	-.05	.00	.21
Passage Comprehension (Grw/Glr)	.67	.44	.49	.24	.13	.02	-.03	.00	.04	.00	-.06	.00	.05
Reading Recall (Grw/Glr)	.51	.26	.43	.19	-.08	.01	.02	.00	-.04	.00	-.03	.00	.20
Oral Reading (Grw)	.60	.36	.40	.16	.18	.03	.11	.01	.14	.02	-.08	.01	-.16
Spelling (Grw)	.72	.51	.39	.16	.10	.01	.16	.02	-.05	.00	.08	.01	.02
Spelling of Sounds (Ga/Grw)	.59	.34	.36	.13	-.13	.02	-.03	.00	.25	.06	.15	.02	.07
Editing (Grw)	.71	.51	.32	.10	.16	.03	.10	.01	-.10	.01	.11	.01	.09
Sound Awareness (Grw/Ga)	.59	.35	.32	.10	-.06	.00	-.02	.00	.23	.05	.18	.03	.00
General Information (Gc)	.55	.30	-.02	.00	.60	.36	.04	.00	.17	.03	-.14	.02	-.13
Picture Vocabulary (Gc)	.60	.36	.00	.00	.60	.36	-.05	.00	-.04	.00	.03	.00	-.03
Social Studies (Gc)	.63	.39	.00	.00	.50	.25	-.04	.00	-.11	.01	.01	.00	.23
Oral Vocabulary (Gc)	.68	.47	.08	.01	.48	.23	-.02	.00	.06	.00	.01	.00	.04
Humanities (Gc)	.61	.37	-.08	.01	.48	.23	-.03	.00	.07	.00	.08	.01	.10
Oral Comprehension (Gc)	.60	.36	.16	.02	.41	.16	-.12	.01	-.01	.00	.10	.01	-.02
Reading Vocabulary (Grw/Gc)	.72	.52	.29	.08	.35	.12	.00	.00	.02	.00	-.02	.00	.04
Science (Gc)	.61	.37	.05	.00	.34	.11	-.17	.03	-.13	.02	.14	.02	.35
Letter-Pattern Matching (Gs)	.48	.23	-.03	.00	-.08	.01	.61	.37	.07	.01	.00	.00	.00
Word Reading Fluency (Grw/Gs)	.58	.34	.09	.01	.05	.00	.60	.36	-.10	.01	.02	.00	-.06
Number-Pattern Matching (PerSpd)	.49	.24	.13	.02	-.17	.03	.54	.29	-.03	.00	.00	.00	.09
Pair Cancellation (Gs)	.42	.18	-.17	.03	-.01	.00	.54	.29	-.04	.00	.10	.01	.07
Sentence Reading Fluency (Grw/Gs)	.65	.42	.27	.07	.05	.00	.49	.24	-.02	.00	-.03	.00	-.10
Math Fact Fluency (Gq/Gs)	.60	.36	.15	.02	.03	.00	.47	.22	-.04	.00	-.05	.00	.09
Sentence Writing Fluency (Grw/Gs)	.61	.37	.31	.09	-.11	.01	.42	.17	-.04	.00	.03	.00	.03
Numbers Reversed (Gwm)	.51	.26	-.01	.00	.04	.00	.17	.03	.15	.02	.13	.02	.11
Sound Blending (Ga)	.37	.14	-.01	.00	.08	.01	-.11	.01	.54	.29	.06	.00	-.07
Visual-Auditory Learning (Glr)	.37	.14	-.01	.00	.00	.00	.01	.00	.51	.26	-.03	.00	.04
Visualization (Gv)	.45	.20	.03	.00	.03	.00	.03	.00	.46	.21	-.03	.00	.07
Segmentation (Ga)	.44	.19	.15	.02	-.12	.01	-.16	.03	.39	.16	.19	.04	.11
Concept Formation (Gf)	.52	.27	-.04	.00	.06	.00	.04	.00	.34	.11	.02	.00	.24

Memory for Words (Aud Mem)	.49	.24	-.06	.00	-.02	.00	.00	.19	.04	.45	.20	-.01
Verbal Attention (Gwm)	.58	.33	.10	.01	-.02	.00	.03	-.06	.00	.44	.20	.07
Sentence Repetition (Gwm)	.54	.29	.14	.02	.11	.01	-.01	-.11	.01	.44	.19	-.11
Nonword Repetition (Ga)	.47	.22	.16	.03	-.03	.00	-.03	.10	.01	.40	.16	-.16
Object-Number Sequencing (Gwm)	.54	.29	-.21	.04	.02	.00	.26	.14	.02	.36	.13	.04
Phonological Processing (Ga)	.63	.39	.09	.01	.02	.00	.02	.19	.04	.31	.09	.07
Rapid Picture Naming (Gs/Glr)	.42	.18	-.08	.01	.12	.01	.28	-.11	.01	.27	.07	-.10
Understanding Directions (Gwm)	.54	.29	.09	.01	.05	.00	.01	.08	.01	.23	.05	.08
Retrieval Fluency (Glr/Gs)	.48	.23	-.10	.01	.16	.03	.21	-.07	.01	.20	.04	.09
Number Series (Gf)	.64	.41	.31	.10	-.09	.01	.02	-.02	.00	-.05	.00	.56
Calculation (Gq/Gs)	.65	.42	.20	.04	.01	.00	.19	.04	.00	-.13	.02	.45
Number Matrices (Gf)	.59	.34	.00	.00	.07	.00	.09	.06	.00	.09	.01	.39
Applied Problems (Gq)	.68	.46	.09	.01	.21	.04	.10	.17	.03	-.16	.03	.38
Analysis-Synthesis (Gf)	.49	.24	-.14	.02	.07	.01	.07	.36	.13	-.05	.00	.35
Picture Recognition (Gv)	.32	.10	.06	.00	.01	.00	.11	.26	.07	.03	.00	-.13
Story Recall (Glr)	.46	.21	.05	.00	.11	.01	-.05	.10	.01	.05	.00	.23
Common Variance (%)		53.1		9.3		7.7	8.4		6.0		5.1	
Total Variance (%)		31.9		5.6		4.6	5.1		3.6		3.1	

Note. g = general intelligence factor S^2 = variance explained, h^2 = communality, u^2 = uniqueness, Loadings $\geq .30$ are ***bolded*** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subfactors posited in the WJ-IV Technical Manual is indicted following each subtest name.

Table A4

WJIV Sources of Variance According to a Schmid-Leiman Orthogonalization (7 Factor) Ages 14 to 19

Subtest	Second-Order Factor				First-Order Factors												h ²	u ²
	g	S ²	F1	S ²	F2	S ²	F3	S ²	F4	S ²	F5	S ²	F6	S ²	F7	S ²		
Picture Vocabulary (Gc)	.66	.43	.56	.32	.05	.00	-.02	.00	-.02	.00	.01	.00	-.08	.01	.12	.01	.77	.23
General Information (Gc)	.61	.37	.54	.30	-.02	.00	.04	.00	-.12	.01	.09	.01	-.05	.00	.01	.00	.69	.31
Social Studies (Gc)	.70	.49	.46	.22	-.05	.00	-.02	.00	.01	.00	-.06	.00	.17	.03	-.03	.00	.74	.26
Humanities (Gc)	.68	.46	.45	.20	-.09	.01	-.03	.00	.07	.00	.05	.00	.06	.00	-.07	.00	.68	.32
Oral Vocabulary (Gc)	.74	.55	.44	.19	.07	.00	.00	.00	.00	.00	.06	.00	.04	.00	.00	.00	.75	.25
Oral Comprehension (Gc)	.65	.43	.42	.18	.12	.01	-.10	.01	.12	.01	-.05	.00	-.03	.00	.19	.04	.68	.32
Reading Vocabulary (Grw/Gc)	.74	.55	.38	.14	.28	.08	.00	.00	-.05	.00	.02	.00	.01	.00	-.02	.00	.77	.23
Science (Gc)	.69	.48	.34	.11	.03	.00	-.14	.02	.11	.01	-.07	.00	.22	.05	.01	.00	.68	.32
Letter-Word Identification (Grw)	.69	.48	.13	.02	.53	.28	.04	.00	.02	.00	-.03	.00	-.03	.00	-.02	.00	.78	.22
Reading Recall (Grw/Grl)	.47	.22	-.09	.01	.51	.26	.02	.00	-.07	.00	-.04	.00	.14	.02	.26	.07	.58	.42
Writing Samples (Grw)	.57	.32	-.06	.00	.48	.23	-.02	.00	-.01	.00	.02	.00	.14	.02	.22	.05	.63	.37
Word Attack (Grw/Glr)	.63	.39	-.01	.00	.47	.22	-.11	.01	.19	.03	.11	.01	-.04	.00	.04	.00	.67	.33
Passage Comprehension (Grw/Glr)	.71	.51	.14	.02	.45	.20	.01	.00	-.05	.00	.08	.01	.04	.00	.13	.02	.76	.24
Oral Reading (Grw)	.61	.37	.13	.02	.42	.18	.11	.01	-.08	.01	.16	.03	-.09	.01	-.16	.02	.65	.35
Spelling (Grw)	.72	.52	.12	.01	.35	.12	.13	.02	.11	.01	-.04	.00	.01	.00	-.12	.01	.70	.30
Editing (Grw)	.73	.54	.14	.02	.27	.07	.07	.00	.17	.03	-.12	.01	.11	.01	-.20	.04	.73	.27
Sound Awareness (Grw/Ga)	.63	.39	-.02	.00	.26	.07	-.01	.00	.13	.02	.22	.05	.03	.00	.05	.00	.53	.47
Word Reading Fluency (Grw/Gs)	.53	.29	.07	.01	.08	.01	.63	.39	-.06	.00	-.07	.01	-.07	.01	-.03	.00	.70	.30
Letter-Pattern Matching (Gs)	.52	.27	-.10	.01	.01	.00	.56	.31	.01	.00	.10	.01	.00	.00	.12	.01	.61	.39
Pair Cancellation (Gs)	.49	.24	.01	.00	-.19	.04	.51	.26	.05	.00	.11	.01	.02	.00	-.09	.01	.56	.44
Number-Pattern Matching (PerSpd)	.51	.26	-.13	.02	.10	.01	.51	.26	.05	.00	-.09	.01	.10	.01	.06	.00	.57	.43
Sentence Reading Fluency (Grw/Gs)	.64	.40	.07	.01	.28	.08	.49	.24	-.06	.00	-.03	.00	-.08	.01	.11	.01	.74	.26
Math Fact Fluency (Gq/Gs)	.58	.34	.00	.00	.11	.01	.43	.18	-.04	.00	-.11	.01	.19	.04	-.03	.00	.59	.41
Sentence Writing Fluency (Grw/Gs)	.59	.34	-.09	.01	.32	.10	.41	.16	.01	.00	-.04	.00	.03	.00	.01	.00	.62	.38
Rapid Picture Naming (Gs/Glr)	.38	.15	.08	.01	-.09	.01	.27	.07	.21	.04	.00	.00	-.14	.02	.31	.09	.39	.61
Retrieval Fluency (Glr/Gs)	.51	.26	.18	.03	-.14	.02	.24	.06	.14	.02	.00	.00	.01	.00	.15	.02	.41	.59
Verbal Attention (Gwm)	.61	.37	-.01	.00	.02	.00	.01	.00	.47	.22	-.11	.01	.08	.01	-.08	.01	.62	.38
Memory for Words (Aud Mem)	.53	.29	-.02	.00	-.08	.01	.01	.00	.42	.18	.11	.01	-.02	.00	.08	.01	.49	.51
Sentence Repetition (Gwm)	.56	.32	.11	.01	.13	.02	-.03	.00	.42	.18	-.11	.01	-.10	.01	.09	.01	.55	.45
Nonword Repetition (Ga)	.48	.23	-.05	.00	.12	.01	-.06	.00	.40	.16	.10	.01	-.10	.01	.10	.01	.44	.56
Object-Number Sequencing (Gwm)	.61	.38	.01	.00	-.19	.04	.21	.05	.30	.09	.06	.00	.11	.01	.14	.02	.58	.42

Understanding Directions (Gwm)	.56	.31	-.02	.00	.11	.01	-.01	.00	.26	.07	.00	.00	.11	.01	.25	.06	.47	.53
Numbers Reversed (Gwm)	.60	.35	.00	.00	.01	.00	.10	.01	.18	.03	.11	.01	.14	.02	-.04	.00	.43	.57
Sound Blending (Ga)	.51	.26	.08	.01	-.01	.00	-.03	.00	.03	.00	.50	.25	-.03	.00	-.08	.01	.53	.47
Visual-Auditory Learning (Glr)	.42	.17	.07	.00	.02	.00	.02	.00	-.12	.01	.46	.21	.00	.00	.21	.04	.45	.55
Segmentation (Ga)	.53	.28	-.07	.01	.14	.02	-.09	.01	.11	.01	.45	.20	.02	.00	.06	.00	.53	.47
Spelling of Sounds (Ga/Grw)	.66	.43	-.12	.02	.30	.09	.03	.00	.09	.01	.37	.14	.05	.00	-.18	.03	.72	.28
Concept Formation (Gf)	.58	.34	.06	.00	.00	.00	.02	.00	-.04	.00	.28	.08	.22	.05	.17	.03	.50	.50
Visualization (Gv)	.53	.28	.00	.00	.09	.01	.00	.00	-.03	.00	.28	.08	.16	.03	.23	.05	.44	.56
Phonological Processing (Ga)	.70	.49	.11	.01	.04	.00	.05	.00	.18	.03	.27	.07	.01	.00	-.17	.03	.63	.37
Number Series (Gf)	.68	.46	-.07	.01	.24	.06	-.04	.00	-.01	.00	-.06	.00	.53	.28	-.08	.01	.82	.18
Calculation (Gq/Gs)	.72	.52	.03	.00	.14	.02	.14	.02	-.10	.01	.01	.00	.44	.19	-.12	.01	.78	.22
Applied Problems (Gq)	.75	.56	.20	.04	.05	.00	.07	.00	-.10	.01	.07	.01	.37	.14	-.05	.00	.77	.23
Number Matrices (Gf)	.65	.43	.10	.01	-.06	.00	.03	.00	.07	.00	.04	.00	.37	.14	-.22	.05	.63	.37
Analysis-Synthesis (Gf)	.54	.29	.05	.00	-.14	.02	.05	.00	-.01	.00	.19	.04	.32	.10	.17	.03	.48	.52
Picture Recognition (Gv)	.26	.07	.02	.00	.12	.01	.04	.00	.07	.00	.06	.00	-.10	.01	.70	.49	.59	.41
Story Recall (Glr)	.50	.25	.10	.01	.08	.01	-.08	.01	.06	.00	-.02	.00	.23	.05	.37	.14	.47	.53
Common Variance (%)	59.2			6.8	8.1	7.3		4.3	4.6				4.5		5.1	61.5	38.5	
Total Variance (%)	36.4			4.2	5.0	4.5		2.7	2.8				2.8		3.1			

Note. g = general intelligence factor S^2 = variance explained, h^2 = communality, u^2 = uniqueness, Loadings $\geq .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective CHC stratum I or II factors posited in the WJ-IV Technical Manual is indicated following each subtest name.

Table A5

Age 9- to 13- WJ-IV Principal Axis Factor with Promax Rotation (Eight Factors)

Subtest	Pattern (Structure Coefficients)										h^2	u^2
	I	II	III	IV	V	VI	VII	VIII				
Writing Samples (Grw)	.84 (.72)	-.10 (.34)	.05 (.34)	-.20 (.40)	.05 (.30)	.08 (.24)	.19 (.45)	.25 (.17)	.25 (.11)	.63 .37		
Letter-Word Identification (Grw)	.79 (.88)	.19 (.61)	.05 (.61)	-.03 (.55)	-.03 (.50)	-.04 (.30)	-.01 (.49)	-.03 (-.02)	-.03 (-.20)	.80 .20		
Word Attack (Grw/Glr)	.75 (.75)	-.04 (.46)	-.14 (.46)	.23 (.37)	.13 (.56)	.11 (.43)	.05 (.39)	.04 (.04)	-.01 (-.11)	.63 .37		
Passage Comprehension (Grw/Glr)	.73 (.81)	.22 (.60)	-.02 (.60)	-.11 (.48)	.08 (.47)	-.01 (.37)	.15 (.50)	.15 (.15)	-.01 (-.15)	.71 .29		
Reading Recall (Grw/Glr)	.64 (.66)	-.11 (.35)	-.01 (.35)	.02 (.42)	-.09 (.37)	.21 (.21)	.10 (.49)	.04 (.11)	-.04 (-.07)	.48 .52		
Spelling (Grw)	.53 (.81)	.12 (.60)	.14 (.60)	.18 (.64)	-.05 (.60)	.03 (.35)	-.09 (.54)	-.06 (-.06)	-.14 (-.30)	.75 .25		
Oral Reading (Grw)	.50 (.72)	.20 (.54)	.06 (.54)	-.01 (.53)	.13 (.45)	-.09 (.39)	-.09 (.38)	-.09 (-.09)	-.41 (-.54)	.74 .26		
Spelling of Sounds (Ga/Grw)	.48 (.65)	-.19 (.36)	-.05 (.36)	.14 (.41)	.40 (.54)	.11 (.61)	.15 (.48)	-.11 (-.11)	-.11 (-.23)	.63 .37		
Editing (Grw)	.45 (.77)	.24 (.65)	.09 (.65)	.16 (.58)	-.04 (.59)	.10 (.35)	.10 (.55)	-.19 (-.13)	-.07 (-.22)	.72 .28		
Sounds Awareness (Grw/Ga)	.43 (.61)	-.09 (.42)	-.01 (.42)	.21 (.41)	.32 (.57)	.00 (.45)	.05 (.45)	.05 (.09)	-.05 (-.15)	.53 .47		
Picture Vocabulary (Gc)	.00 (.45)	.91 (.86)	-.05 (.86)	.02 (.34)	-.05 (.50)	-.06 (.38)	.05 (.38)	.05 (.14)	.01 (-.05)	.74 .26		
General Information (Gc)	-.08 (.40)	.85 (.78)	-.01 (.78)	-.11 (.37)	.06 (.41)	-.03 (.33)	.07 (.37)	.12 (.15)	-.29 (-.35)	.70 .30		
Social Studies (Gc)	.03 (.50)	.78 (.81)	-.02 (.81)	-.06 (.39)	-.09 (.48)	.22 (.27)	-.08 (.54)	.13 (.04)	-.06 (-.14)	.70 .30		
Humanities (Gc)	-.12 (.41)	.74 (.77)	-.01 (.77)	.01 (.36)	.14 (.52)	.12 (.43)	.12 (.48)	.02 (.02)	-.02 (-.05)	.63 .37		
Oral Vocabulary (Gc)	.10 (.56)	.71 (.83)	-.03 (.83)	.02 (.44)	.04 (.56)	.07 (.40)	.07 (.52)	.04 (.14)	-.06 (-.14)	.70 .30		
Oral Comprehension (Gc)	.25 (.51)	.64 (.75)	-.11 (.75)	.11 (.31)	-.03 (.53)	-.11 (.32)	.26 (.39)	.12 (.32)	.12 (.07)	.67 .33		
Science (Gc)	.11 (.49)	.56 (.71)	-.18 (.71)	.12 (.28)	-.09 (.53)	.33 (.30)	-.08 (.57)	.26 (.05)	.26 (.21)	.67 .33		
Reading Vocabulary (Grw/Gc)	.43 (.74)	.56 (.78)	.04 (.78)	-.12 (.51)	.13 (.53)	-.02 (.43)	-.05 (.51)	-.05 (.01)	-.02 (-.17)	.75 .25		
Letter-Pattern Matching (Gs)	-.01 (.40)	-.11 (.27)	.84 (.44)	.77 (.77)	.08 (.34)	.04 (.24)	.04 (.43)	.09 (.15)	.05 (-.16)	.61 .39		
Word Reading Fluency (Grw/Gs)	.15 (.57)	.07 (.44)	.81 (.84)	-.04 (.84)	-.06 (.41)	-.08 (.19)	-.08 (.43)	-.05 (.00)	.01 (-.23)	.73 .27		
Number-Pattern Matching (PerSpd)	.26 (.51)	-.21 (.25)	.79 (.76)	-.14 (.76)	.01 (.31)	.05 (.19)	.05 (.46)	.14 (.18)	.21 (-.02)	.68 .32		
Pair Cancellation (Gs)	-.20 (.27)	.02 (.29)	.78 (.66)	-.01 (.66)	.03 (.33)	.07 (.19)	.07 (.39)	-.02 (.09)	.20 (.02)	.50 .50		
Sentence Reading Fluency (Grw/Gs)	.36 (.70)	.04 (.50)	.59 (.82)	.03 (.82)	-.09 (.48)	.24 (.24)	-.06 (.48)	.09 (.11)	-.16 (-.37)	.78 .22		
Math Fact Fluency (Gq/Gs)	.18 (.60)	-.01 (.43)	.53 (.77)	.05 (.77)	-.18 (.44)	.22 (.18)	.22 (.57)	-.01 (.05)	-.15 (-.32)	.67 .33		
Sentence Writing Fluency (Grw/Gs)	.43 (.69)	-.19 (.37)	.50 (.75)	.09 (.75)	-.08 (.47)	.08 (.24)	.08 (.52)	.02 (.04)	-.07 (-.27)	.68 .32		
Retrieval Fluency (Glr/Gs)	-.07 (.32)	.34 (.50)	.45 (.47)	.01 (.47)	.11 (.42)	-.06 (.30)	.02 (.36)	.02 (.13)	.40 (.26)	.48 .52		
Rapid Picture Naming (Gs/Glr)	-.09 (.26)	.21 (.41)	.43 (.45)	.30 (.45)	-.09 (.46)	.19 (.19)	-.20 (.25)	.21 (.28)	.25 (.14)	.42 .58		
Nonword Repetition (Ga)	.15 (.37)	-.09 (.36)	-.15 (.36)	.26 (.26)	.02 (.67)	-.12 (.41)	.16 (.28)	.16 (.20)	-.12 (-.12)	.50 .50		
Sentence Repetition (Gwm)	.15 (.45)	.14 (.51)	-.09 (.51)	.74 (.33)	-.14 (.71)	-.13 (.32)	.02 (.31)	.02 (.08)	.00 (-.04)	.55 .45		
Verbal Attention (Gwm)	.10 (.46)	-.05 (.44)	-.03 (.44)	.72 (.39)	-.08 (.73)	.12 (.38)	.12 (.46)	-.07 (.03)	.05 (.01)	.55 .45		
Memory for Words (Aud Mem)	-.12 (.27)	-.01 (.38)	.02 (.38)	.55 (.29)	.30 (.66)	.00 (.57)	.00 (.36)	.00 (.12)	.11 (.07)	.50 .50		

Object-Number Sequencing (Gwm)	-.33	(.24)	.02	(.42)	.30	(.49)	.55	(.67)	.07	(.44)	.15	(.49)	.11	(.26)	.07	(.01)	.57	.43
Understanding Directions (Gwm)	.10	(.41)	.04	(.45)	-.08	(.35)	.50	(.61)	-.10	(.33)	.19	(.49)	.24	(.32)	-.01	(-.02)	.47	.53
Sound Blending (Ga)	-.03	(.21)	.14	(.32)	-.05	(.16)	-.11	(.35)	.73	(.70)	-.05	(.26)	.06	(.14)	-.09	(-.14)	.51	.49
Segmentation (Ga)	.26	(.37)	-.12	(.26)	-.07	(.19)	-.02	(.43)	.69	(.71)	.05	(.37)	.06	(.14)	.20	(.12)	.57	.43
Phonological Processing (Ga)	.15	(.52)	.11	(.50)	.17	(.44)	.13	(.62)	.54	(.70)	-.04	(.46)	-.19	(-.08)	.22	(.07)	.67	.33
Visual-Auditory Learning (Glr)	-.03	(.21)	-.02	(.26)	.01	(.24)	-.05	(.33)	.45	(.53)	.19	(.40)	.28	(.36)	-.12	(-.14)	.40	.60
Number Series (Gf)	.47	(.71)	-.12	(.43)	-.04	(.50)	-.02	(.45)	-.09	(.29)	.71	(.81)	-.10	(-.01)	.08	(-.02)	.80	.20
Applied Problems (Gq)	.11	(.58)	.27	(.62)	.03	(.54)	-.11	(.47)	-.03	(.36)	.64	(.80)	.05	(.18)	-.11	(-.20)	.72	.28
Calculations (Gq/Gs)	.30	(.66)	.00	(.47)	.18	(.62)	-.12	(.42)	-.08	(.28)	.64	(.79)	-.07	(.03)	-.01	(-.15)	.73	.27
Analysis-Synthesis (Gf)	-.18	(.26)	.11	(.40)	.10	(.37)	-.11	(.38)	.27	(.47)	.55	(.65)	.17	(.32)	.09	(.04)	.53	.47
Number Matrices (Gf)	-.01	(.47)	.10	(.47)	.07	(.46)	.12	(.50)	.05	(.39)	.55	(.68)	-.22	(-.08)	.04	(-.05)	.53	.47
Concept Formation (Gf)	-.09	(.32)	.05	(.41)	-.02	(.36)	.11	(.47)	.18	(.47)	.47	(.62)	.18	(.30)	-.06	(-.09)	.47	.53
Story Recall (Glr)	.10	(.34)	.17	(.43)	-.07	(.26)	.10	(.41)	-.02	(.28)	.29	(.49)	.29	(.38)	.16	(.14)	.40	.60
Numbers Reversed (Gwm)	-.05	(.38)	.02	(.39)	.16	(.46)	.24	(.51)	.10	(.39)	.26	(.50)	-.03	(.08)	-.08	(-.16)	.36	.64
Picture Recognition (Gv)	.10	(.20)	.02	(.26)	.16	(.28)	.10	(.32)	.07	(.25)	-.10	(.25)	.66	(.68)	.06	(.03)	.54	.46
Visualization (Gv)	.00	(.29)	-.01	(.33)	-.04	(.31)	.08	(.42)	.26	(.48)	.30	(.50)	.36	(.44)	-.18	(-.20)	.48	.52
Eigenvalue	18.30		3.18		2.51		2.17		1.65		1.41		1.36		1.17			
Variance (%)	38.94		6.78		5.35		4.62		3.52		3.00		2.89		2.50			
Factor 1	1.0																	
Factor 2	.57	1.0																
Factor 3	.58	.47	1.0															
Factor 4	.54	.61	.51	1.0														
Factor 5	.35	.40	.29	.58	1.0													
Factor 6	.55	.52	.55	.54	.44	1.0												
Factor 7	-.02	.12	.09	.13	.13	.18	1.0											
Factor 8	-.18	-.09	-.26	-.05	-.09	-.06	.06	1.0										

Note. h^2 = Communality coefficient. u^2 = Uniqueness. Pattern coefficients $> .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective CHC stratum I or II factors posited in the WJ-IV Technical Manual is indicated following each subtest name.

Table A6

WJIV Sources of Variance According to a Schmid-Leiman Orthogonalization (8 Factor) Ages 9 to 13

Subtest	Second-Order Factor			First-Order Factors										
	<i>g</i>	<i>S</i> ²	F1	<i>S</i> ²	F2	<i>S</i> ²	F3	<i>S</i> ²	F4	<i>S</i> ²	F5	<i>S</i> ²	F6	<i>S</i> ²
Writing Samples (Grw)	.49	.24	.57	.32	-.07	.00	.04	.00	-.12	.01	.04	.00	.05	.00
Letter-Word Identification (Grw)	.69	.47	.54	.29	.13	.02	.03	.00	-.02	.00	-.03	.00	-.03	.00
Word Attack (Grw/Glr)	.61	.37	.51	.26	-.03	.00	-.10	.01	.14	.02	.11	.01	-.07	.01
Passage Comprehension (Grw/Glr)	.66	.43	.50	.25	.15	.02	-.02	.00	-.07	.00	.06	.00	.00	.00
Reading Recall (Grw/Glr)	.52	.27	.43	.19	-.07	.01	-.01	.00	.01	.00	-.07	.01	.15	.02
Spelling (Grw)	.73	.53	.36	.13	.09	.01	.10	.01	.11	.01	-.04	.00	.02	.00
Oral Reading (Grw)	.62	.38	.34	.12	.14	.02	.04	.00	.00	.00	.11	.01	-.06	.00
Spelling of Sounds (Ga/Grw)	.60	.36	.33	.11	-.13	.02	-.03	.00	.09	.01	.33	.11	.07	.01
Editing (Grw)	.72	.52	.30	.09	.16	.03	.07	.00	.10	.01	-.04	.00	.06	.00
Sounds Awareness (Grw/Ga)	.61	.37	.29	.08	-.06	.00	-.01	.00	.13	.02	.26	.07	.00	.00
Picture Vocabulary (Gc)	.58	.34	.00	.00	.62	.39	-.04	.00	.01	.00	-.04	.00	-.04	.00
General Information (Gc)	.54	.29	-.06	.00	.58	.34	-.01	.00	-.06	.00	.05	.00	-.02	.00
Social Studies (Gc)	.61	.37	.02	.00	.53	.28	-.02	.00	-.03	.00	-.07	.01	.15	.02
Humanities (Gc)	.60	.36	-.08	.01	.50	.25	-.01	.00	.01	.00	.11	.01	.08	.01
Oral Vocabulary (Gc)	.68	.46	.07	.00	.49	.24	-.02	.00	.01	.00	.03	.00	.05	.00
Oral Comprehension (Gc)	.59	.34	.17	.03	.44	.19	-.08	.01	.06	.00	-.02	.00	-.07	.01
Science (Gc)	.59	.35	.07	.01	.38	.14	-.13	.02	.07	.01	-.07	.01	.22	.05
Reading Vocabulary (Grw/Gc)	.71	.50	.29	.08	.38	.14	.03	.00	-.07	.01	.11	.01	-.01	.00
Letter-Pattern Matching (Gs)	.49	.24	-.01	.00	-.07	.01	.61	.37	-.06	.00	.06	.00	.02	.00
Word Reading Fluency (Grw/Gs)	.59	.35	.10	.01	.05	.00	.59	.34	-.03	.00	-.05	.00	-.05	.00
Number-Pattern Matching (PerSpd)	.50	.25	.17	.03	-.14	.02	.58	.33	-.09	.01	.01	.00	.03	.00
Pair Cancellation (Gs)	.43	.18	-.14	.02	.02	.00	.57	.32	-.01	.00	.02	.00	.04	.00
Sentence Reading Fluency (Grw/Gs)	.67	.45	.24	.06	.03	.00	.42	.18	.02	.00	-.08	.01	-.04	.00
Math Fact Fluency (Gq/Gs)	.62	.38	.12	.02	-.01	.00	.39	.15	.03	.00	-.15	.02	.15	.02
Sentence Writing Fluency (Grw/Gs)	.63	.39	.29	.09	-.13	.02	.36	.13	.05	.00	-.06	.00	.05	.00
Retrieval Fluency (Glr/Gs)	.47	.22	-.05	.00	.24	.06	.33	.11	.01	.00	.09	.01	-.04	.00
Rapid Picture Naming (Gs/Glr)	.42	.18	-.06	.00	.15	.02	.31	.10	.18	.03	-.07	.00	-.14	.02
Nonword Repetition (Ga)	.50	.25	.10	.01	-.06	.00	-.11	.01	.46	.21	.02	.00	-.08	.01
Sentence Repetition (Gwm)	.56	.31	.10	.01	.09	.01	-.07	.00	.45	.21	-.12	.01	-.09	.01
Verbal Attention (Gwm)	.60	.36	.07	.00	-.04	.00	-.02	.00	.44	.19	-.06	.00	.08	.01
Memory for Words (Aud Mem)	.51	.26	-.08	.01	-.01	.00	.02	.00	.34	.11	.25	.06	.00	.00

Object-Number Sequencing (Gwm)	.56	.32	-.22	.05	.01	.00	.22	.05	.34	.11	.06	.00	.10	.01
Understanding Directions (Gwm)	.56	.32	.07	.00	.03	.00	-.06	.00	.31	.09	-.08	.01	.13	.02
Sound Blending (Ga)	.36	.13	-.02	.00	.10	.01	-.04	.00	-.07	.00	.60	.36	-.03	.00
Segmentation (Ga)	.43	.19	.17	.03	-.09	.01	-.05	.00	-.01	.00	.56	.32	.03	.00
Phonological Processing (Ga)	.63	.39	.10	.01	.07	.01	.13	.02	.08	.01	.45	.20	-.02	.00
Visual-Auditory Learning (Glr)	.38	.14	-.02	.00	-.02	.00	.00	.00	-.03	.00	.37	.14	.13	.02
Number Series (Gf)	.66	.43	.32	.10	-.08	.01	-.03	.00	-.01	.00	-.08	.01	.48	.23
Applied Problems (Gq)	.69	.48	.08	.01	.19	.03	.02	.00	-.07	.00	-.03	.00	.43	.19
Calculations (Gq/Gs)	.66	.44	.20	.04	.00	.00	.13	.02	-.08	.01	-.06	.00	.43	.18
Analysis-Synthesis (Gf)	.50	.25	-.12	.01	.08	.01	.07	.01	-.07	.00	.22	.05	.37	.14
Number Matrices (Gf)	.60	.36	.00	.00	.07	.00	.05	.00	.07	.00	.04	.00	.37	.14
Concept Formation (Gf)	.54	.29	-.06	.00	.04	.00	-.01	.00	.06	.00	.15	.02	.32	.10
Story Recall (Glr)	.46	.21	.07	.00	.12	.01	-.05	.00	.06	.00	-.02	.00	.20	.04
Numbers Reversed (Gwm)	.54	.29	-.03	.00	.02	.00	.12	.01	.15	.02	.08	.01	.17	.03
Picture Recognition (Gv)	.33	.11	.07	.00	.01	.00	.11	.01	.06	.00	.06	.00	-.07	.00
Visualization (Gv)	.47	.22	.00	.00	-.01	.00	-.03	.00	.05	.00	.22	.05	.20	.04
Common Variance (%)	53.3			8.7		8.1		7.8		4.0		5.4		4.7
Total Variance (%)	32.7			5.3		4.9		4.8		2.4		3.3		2.9

Note. g = general intelligence factor S^2 = variance explained, h^2 = communality, u^2 = uniqueness, Loadings $\geq .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests in the WJ-IV Technical Manual is indicated following each subtest name.

Table A7

Age 14- to 19- WJ-IV Principal Axis Factor with Promax Rotation (Eight Factors)

Subtest	Pattern (Structure Coefficients)								h^2	u^2
	I	II	III	IV	V	VI	VII	VIII		
Picture Vocabulary (Gc)	.95 (.86)	.04 (.51)	-.04 (.43)	-.03 (.43)	.00 (.55)	-.12 (.44)	.12 (.44)	.02 (.12)	.76 (.10)	.24
General Information (Gc)	.91 (.81)	-.14 (.41)	.01 (.44)	-.10 (.44)	.10 (.46)	-.05 (.44)	.03 (.44)	.19 (.07)	.70 (.26)	.30
Social Studies (Gc)	.80 (.84)	-.01 (.52)	-.01 (.46)	-.08 (.43)	-.07 (.55)	.25 (.61)	-.04 (.53)	-.15 (.00)	.74 (-.04)	.26
Humanities (Gc)	.75 (.81)	-.14 (.45)	-.06 (.43)	.11 (.60)	.07 (.60)	.11 (.53)	-.07 (.53)	.00 (.01)	.67 (.05)	.33
Oral Comprehension (Gc)	.74 (.79)	.23 (.57)	-.11 (.38)	.07 (.59)	-.06 (.43)	-.06 (.46)	.18 (.14)	-.17 (-.09)	.70 (.13)	.30
Oral Vocabulary (Gc)	.73 (.86)	.06 (.59)	.00 (.52)	.00 (.61)	.08 (.58)	.07 (.58)	.00 (.58)	.04 (.04)	.74 (.13)	.26
Reading Vocabulary (Grw/Gc)	.64 (.84)	.34 (.73)	.01 (.55)	-.08 (.47)	.03 (.47)	.02 (.56)	-.02 (.56)	.11 (-.04)	.79 (.23)	.21
Science (Gc)	.59 (.76)	.13 (.56)	-.16 (.39)	.07 (.60)	-.07 (.45)	.34 (.64)	-.01 (.02)	-.18 (-.10)	.69 (.05)	.31
Writing Samples (Grw)	-.08 (.44)	.77 (.73)	.03 (.44)	-.16 (.43)	.05 (.40)	.20 (.53)	.21 (.15)	-.11 (.03)	.61 (.03)	.39
Letter-Word Identification (Grw)	.25 (.68)	.74 (.88)	.10 (.58)	-.04 (.56)	-.01 (.41)	-.07 (.49)	-.03 (.12)	.06 (.20)	.82 (.20)	.18
Word Attack (Gr/Glr)	.00 (.54)	.71 (.79)	-.11 (.40)	.17 (.61)	.18 (.52)	-.09 (.42)	.02 (.05)	-.05 (.00)	.68 (.00)	.32
Reading Recall (Grw/Glr)	-.14 (.34)	.65 (.61)	.02 (.42)	-.05 (.35)	-.09 (.25)	.22 (.48)	.26 (.21)	.15 (.27)	.51 (.27)	.49
Passage Comprehension (Grw/Glr)	.26 (.68)	.64 (.81)	.05 (.56)	-.15 (.55)	.12 (.51)	.05 (.57)	.12 (.08)	.04 (.17)	.74 (.17)	.26
Spelling (Grw)	.20 (.69)	.40 (.77)	.17 (.65)	.22 (.65)	-.05 (.42)	.01 (.54)	-.11 (.12)	.17 (.27)	.74 (.27)	.26
Sound Awareness (Grw/Ga)	-.02 (.51)	.34 (.60)	-.01 (.45)	.20 (.60)	.30 (.59)	.05 (.50)	.06 (.09)	.06 (.09)	.51 (.09)	.49
Word Reading Fluency (Grw/Gs)	.12 (.47)	.04 (.46)	.88 (.83)	-.07 (.40)	-.10 (.24)	-.10 (.40)	-.03 (.00)	.04 (.27)	.72 (.27)	.28
Letter-Pattern Matching (Gs)	-.17 (.34)	.00 (.37)	.79 (.75)	.00 (.44)	.13 (.40)	.02 (.45)	.12 (.20)	-.07 (.11)	.61 (.11)	.39
Pair Cancellation (Gs)	.03 (.38)	-.19 (.29)	.79 (.68)	-.09 (.40)	.19 (.40)	.03 (.40)	-.11 (.01)	-.26 (-.10)	.57 (.10)	.43
Number-Pattern Matching (PerSpd)	-.21 (.32)	.22 (.47)	.78 (.74)	-.06 (.40)	-.10 (.26)	.14 (.47)	.05 (.07)	-.23 (.00)	.63 (.36)	.37
Sentence Reading Fluency (Grw/Gs)	.11 (.56)	.28 (.62)	.67 (.83)	-.02 (.51)	-.07 (.33)	-.11 (.48)	.11 (.12)	.15 (.36)	.77 (.36)	.23
Math Fact Fluency (Gq/Gs)	-.02 (.46)	.06 (.49)	.58 (.75)	.02 (.45)	-.17 (.25)	.31 (.60)	-.02 (.06)	.09 (.29)	.63 (.29)	.37
Sentence Writing Fluency (Grw/Gs)	-.15 (.43)	.35 (.62)	.56 (.75)	.07 (.49)	-.07 (.31)	.06 (.50)	.01 (.03)	.13 (.31)	.65 (.31)	.35
Rapid Picture Naming (Gs/Glr)	.15 (.34)	-.03 (.22)	.43 (.42)	.18 (.42)	.02 (.32)	-.24 (.22)	.29 (.29)	-.33 (-.23)	.41 (.23)	.59
Retrieval Fluency (Glr/Gs)	.32 (.50)	-.10 (.30)	.40 (.49)	.06 (.48)	.02 (.38)	.00 (.39)	.14 (.18)	-.33 (-.21)	.45 (.21)	.55
Verbal Attention (Gwm)	-.01 (.51)	.00 (.47)	-.02 (.43)	.80 (.76)	-.15 (.39)	.13 (.48)	-.08 (.01)	-.04 (-.05)	.59 (.05)	.41
Nonword Repetition (Ga)	-.11 (.37)	.07 (.37)	-.14 (.29)	.78 (.67)	.12 (.46)	-.14 (.30)	.12 (.16)	.12 (.05)	.49 (.05)	.51
Sentence Repetition (Gwm)	.19 (.55)	.13 (.48)	-.07 (.37)	.72 (.71)	-.15 (.36)	-.16 (.33)	.09 (.08)	-.01 (-.01)	.55 (.01)	.45
Memory for Words (Aud Mem)	-.03 (.42)	-.12 (.31)	-.01 (.35)	.71 (.69)	.15 (.52)	-.03 (.38)	.08 (.17)	-.07 (-.12)	.52 (.12)	.48
Object-Number Sequencing (Gwm)	.01 (.48)	-.30 (.28)	.26 (.54)	.55 (.69)	.06 (.51)	.19 (.55)	.15 (.29)	-.07 (-.04)	.62 (.04)	.38
Understanding Directions (Gwm)	-.04 (.43)	.14 (.42)	-.04 (.38)	.46 (.61)	-.02 (.43)	.18 (.51)	.25 (.30)	-.05 (-.02)	.47 (.02)	.53
Numbers Reversed (Gwm)	-.01 (.48)	-.02 (.43)	.12 (.48)	.32 (.59)	.14 (.49)	.24 (.54)	-.04 (.07)	.02 (.06)	.43 (.06)	.57

Editing (Grw)	.24	(.71)	.30	(.74)	.08	(.60)	.32	(.68)	-.16	(.38)	.17	(.60)	-.20	-(.18)	.13	(.22)	.76	.24
Sound Blending (Ga)	.13	(.45)	-.04	(.34)	-.05	(.30)	.04	(.47)	.69	(.71)	-.03	(.37)	-.07	(.04)	.08	(.03)	.52	.48
Segmentation (Ga)	-.11	(.39)	.30	(.48)	-.08	(.29)	.00	(.50)	.66	(.74)	.03	(.41)	.05	(.10)	-.14	(-.16)	.60	.40
Visual-Auditory Learning (Glrr)	.10	(.35)	-.01	(.24)	.00	(.28)	-.14	(.33)	.60	(.60)	.03	(.37)	.23	(.32)	.11	(.11)	.44	.56
Spelling of Sounds (Ga/Grw)	-.20	(.48)	.40	(.68)	.06	(.50)	.10	(.60)	.53	(.70)	.08	(.52)	-.18	-(.12)	.10	(.12)	.71	.29
Phonological Processing (Ga)	.20	(.63)	.10	(.57)	.12	(.50)	.15	(.66)	.41	(.69)	.01	(.50)	-.19	-(.11)	-.11	(-.09)	.66	.34
Visualization (Gv)	-.02	(.40)	.03	(.34)	-.06	(.37)	.09	(.46)	.34	(.56)	.29	(.55)	.26	(.37)	.17	(.19)	.49	.51
Number Series (Gf)	-.11	(.51)	.39	(.67)	-.03	(.51)	-.06	(.50)	-.08	(.40)	.82	(.85)	-.08	-(.01)	-.05	(.08)	.81	.19
Calculation (Gq/Gs)	.06	(.60)	.18	(.62)	.19	(.65)	-.14	(.51)	.00	(.45)	.69	(.84)	-.11	(.00)	.05	(.21)	.79	.21
Applied Problems (Gq)	.32	(.71)	.02	(.56)	.07	(.59)	-.10	(.55)	.08	(.52)	.60	(.82)	-.04	(.08)	.10	(.22)	.76	.24
Number Matrices (Gf)	.17	(.58)	-.08	(.46)	.04	(.49)	.11	(.55)	.06	(.47)	.57	(.71)	-.22	-(.08)	-.02	(.05)	.59	.41
Analysis-Synthesis (Gf)	.08	(.43)	-.15	(.26)	.06	(.39)	-.02	(.44)	.24	(.52)	.50	(.64)	.18	(.32)	-.11	(-.05)	.52	.48
Concept Formation (Gf)	.08	(.47)	-.03	(.35)	.01	(.41)	-.02	(.47)	.36	(.60)	.36	(.62)	.18	(.31)	.04	(.08)	.52	.48
Picture Recognition (Gv)	.03	(.20)	.19	(.15)	.06	(.20)	.11	(.29)	.05	(.28)	-.14	(.20)	.70	(.66)	-.14	(-.08)	.53	.47
Story Recall (Glrr)	.16	(.44)	.10	(.34)	-.14	(.31)	.16	(.45)	-.07	(.35)	.37	(.56)	.38	(.43)	-.02	(.04)	.48	.52
Oral Reading (Grw)	.20	(.61)	.38	(.70)	.09	(.57)	.06	(.50)	.21	(.44)	-.13	(.42)	-.14	-(.13)	.48	(.54)	.78	.22
Eigenvalue	19.96		2.78		2.47		1.89		1.65		1.42		1.29		1.03			
Variance (%)	42.48		5.29		5.26		4.02		3.51		3.03		2.75		2.20			
Factor 1	1.0																	
Factor 2	.62	1.0																
Factor 3	.55	.55	1.0															
Factor 4	.67	.60	.57	1.0														
Factor 5	.52	.45	.41	.62	1.0													
Factor 6	.59	.53	.58	.58	.52	1.0												
Factor 7	.03	-.12	.08	.09	.15	.18	1.0											
Factor 8	.10	.13	.25	-.03	-.05	.12	.06	1.0										

Note. h^2 = Communality coefficient. u^2 = Uniqueness. Pattern coefficients > .30 are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests with respective CHC stratum I or II factors posited in the WJ-IV Technical Manual is indicated following each subtest name.

Table A8

WJIV Sources of Variance According to a Schmid-Leiman Orthogonalization (8 Factor) Ages 14 to 19

Subtest	Second-Order Factor			First-Order Factors											
	g	S ²	F1	S ²	F2	S ²	F3	S ²	F4	S ²	F5	S ²	F6	S ²	
Picture Vocabulary (Gc)	.66	.43	.57	.32	.03	.00	-.03	.00	-.02	.00	.00	.00	-.08	.01	
General Information (Gc)	.60	.36	.55	.30	-.09	.01	.01	.00	-.06	.00	.07	.01	-.03	.00	
Social Studies (Gc)	.69	.47	.48	.23	.00	.00	.00	.00	-.05	.00	-.05	.00	.16	.03	
Humanities (Gc)	.67	.45	.45	.20	-.10	.01	-.04	.00	.07	.00	.05	.00	.07	.01	
Oral Comprehension (Gc)	.65	.43	.44	.20	.16	.02	-.08	.01	.04	.00	-.05	.00	-.04	.00	
Oral Vocabulary (Gc)	.74	.55	.44	.19	.04	.00	.00	.00	.00	.00	.06	.00	.05	.00	
Reading Vocabulary (Grw/Gc)	.75	.56	.38	.15	.23	.05	.01	.00	-.04	.00	.02	.00	.01	.00	
Science (Gc)	.69	.47	.35	.13	.09	.01	-.11	.01	.04	.00	-.06	.00	.22	.05	
Writing Samples (Grw)	.57	.33	-.05	.00	.53	.28	.02	.00	-.09	.01	.03	.00	.13	.02	
Letter-Word Identification (Grw)	.71	.51	.15	.02	.50	.25	.07	.00	-.03	.00	-.01	.00	-.05	.00	
Word Attack (Grw/Glr)	.64	.41	.00	.00	.49	.24	-.07	.01	.10	.01	.14	.02	-.06	.00	
Reading Recall (Grw/Glr)	.48	.23	-.09	.01	.45	.20	.01	.00	-.03	.00	-.06	.00	.14	.02	
Passage Comprehension (Grw/Glr)	.72	.52	.16	.02	.44	.19	.03	.00	-.08	.01	.09	.01	.04	.00	
Spelling (Grw)	.74	.55	.12	.01	.28	.08	.12	.01	.13	.02	-.04	.00	.01	.00	
Sound Awareness (Grw/Ga)	.63	.40	-.01	.00	.23	.05	-.01	.00	.11	.01	.23	.05	.03	.00	
Word Reading Fluency (Grw/Gs)	.55	.30	.07	.00	.03	.00	.62	.38	-.04	.00	-.08	.01	-.07	.00	
Letter-Pattern Matching (Gs)	.53	.28	-.10	.01	.00	.00	.56	.31	.00	.00	.10	.01	.01	.00	
Pair Cancellation (Gs)	.49	.24	.02	.00	-.13	.02	.55	.31	-.05	.00	.14	.02	.02	.00	
Number-Pattern Matching (PerSpd)	.51	.26	-.13	.02	.15	.02	.55	.30	-.04	.00	-.08	.01	.09	.01	
Sentence Reading Fluency (Grw/Gs)	.66	.43	.07	.00	.19	.04	.47	.22	-.01	.00	-.05	.00	-.07	.01	
Math Fact Fluency (Gq/Gs)	.60	.35	-.01	.00	.04	.00	.41	.17	.01	.00	-.13	.02	.21	.04	
Sentence Writing Fluency (Grw/Gs)	.61	.37	-.09	.01	.24	.06	.40	.16	.04	.00	-.05	.00	.04	.00	
Rapid Picture Naming (Gs/Glr)	.38	.15	.09	.01	-.02	.00	.30	.09	.10	.01	.01	.00	-.15	.02	
Retrieval Fluency (Glr/Gs)	.50	.25	.19	.04	-.07	.00	.28	.08	.04	.00	.01	.00	.00	.00	
Verbal Attention (Gwm)	.63	.39	-.01	.00	.00	.00	-.01	.00	.45	.21	-.11	.01	.08	.01	
Nonword Repetition (Ga)	.50	.25	-.07	.00	.05	.00	-.10	.01	.44	.19	.09	.01	-.09	.01	
Sentence Repetition (Gwm)	.58	.34	.11	.01	.09	.01	-.05	.00	.41	.16	-.11	.01	-.11	.01	
Memory for Words (Aud Mem)	.54	.29	-.02	.00	-.09	.01	.00	.00	.40	.16	.12	.01	-.02	.00	
Object-Number Sequencing (Gwm)	.62	.38	.01	.00	-.21	.04	.18	.03	.31	.10	.05	.00	.12	.02	
Understanding Directions (Gwm)	.57	.32	-.03	.00	.10	.01	-.03	.00	.26	.07	-.01	.00	.12	.01	
Numbers Reversed (Gwm)	.60	.36	.00	.00	-.02	.00	.08	.01	.18	.03	.11	.01	.15	.02	

Editing (Grw)	.75	.56	.15	.02	.20	.04	.06	.00	.18	.03	-.12	.01	.11	.01
Sound Blending (Ga)	.50	.25	.08	.01	-.03	.00	-.04	.00	.02	.00	.52	.27	-.02	.00
Segmentation (Ga)	.52	.27	-.06	.00	.21	.04	-.06	.00	.00	.00	.50	.25	.02	.00
Visual-Auditory Learning (Glr)	.41	.17	.06	.00	-.01	.00	.00	.00	-.08	.01	.45	.20	.02	.00
Spelling of Sounds (Ga/Grw)	.66	.44	-.12	.01	.28	.08	.04	.00	.05	.00	.40	.16	.05	.00
Phonological Processing (Ga)	.69	.48	.12	.01	.07	.00	.08	.01	.09	.01	.31	.10	.01	.00
Visualization (Gv)	.53	.28	-.01	.00	.02	.00	-.04	.00	.05	.00	.26	.07	.19	.04
Number Series (Gf)	.68	.46	-.07	.00	.27	.07	-.02	.00	-.04	.00	-.06	.00	.54	.29
Calculation (Gq/Gs)	.72	.52	.04	.00	.12	.02	.13	.02	-.08	.01	.00	.00	.45	.20
Applied Problems (Gq)	.74	.55	.19	.04	.02	.00	.05	.00	-.06	.00	.06	.00	.39	.15
Number Matrices (Gf)	.65	.42	.10	.01	-.05	.00	.03	.00	.06	.00	.05	.00	.38	.14
Analysis-Synthesis (Gf)	.53	.28	.05	.00	-.10	.01	.04	.00	-.01	.00	.18	.03	.33	.11
Concept Formation (Gf)	.57	.32	.05	.00	-.02	.00	.01	.00	-.01	.00	.27	.07	.24	.06
Picture Recognition (Gv)	.27	.07	.02	.00	.13	.02	.04	.00	.06	.00	.04	.00	-.10	.01
Story Recall (Glr)	.50	.25	.10	.01	.07	.00	-.10	.01	.09	.01	-.05	.00	.24	.06
Oral Reading (Grw)	.64	.41	.12	.01	.26	.07	.06	.00	.03	.00	.15	.02	-.09	.01
Common Variance (%)	58.1		6.8		6.6		7.2		3.6		4.7		4.6	
Total Variance (%)	36.9		4.3		4.2		4.6		2.3		3.0		3.0	

Note. g = general intelligence factor S^2 = variance explained, h^2 = communality, u^2 = uniqueness, Loadings $\geq .30$ are **bolded** (Carroll, 1993, p. 108; Child, 2006). Note that alignment of subtests in the WJ-IV Technical Manual is indicated following each subtest name.