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WAIS–IV, WISC–V, WPPSI–IV Subtests and their Relationship with CHC Theory

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Abstract: Psychometric intelligence tests have great importance for identification and diagnosis of learning problems, high talents, and cognitive profile in the context of developmental delay or brain injury impacts, for the orientation of specialized education. Among these tests are the three scales of Wechsler, which used frequently. From, the first to the last edition of Wechsler, tests based being, on the created g factor of Spearman. The Cattell-Horn-Carroll theory (CHC) is a complete psychometric theory and empirically based on the structure of cognitive skills. It's used widely as a basis for the creation and classifying batteries of administration intelligence and neuropsychological tests to facilitate interpretation of cognitive performance. For organizing assessments for people suspected of having an intellectual disability, also three Wechsler tests are based on this theory. Our study tends to classify all subtests in the last three American edition versions of the Wechsler tests in this critical theory and compare these tests. We found that the five of The Wechsler Intelligence Scale for Children–Fifth Edition WISC-V primary indexes align with Gc (Comprehension knowledge), Gv (Visual and Spatial Thinking), Gf (Fluid Reasoning), Gwm (Working Memory), Gs (Processing Speed). As well Glr (long-term memory) is measured by two complementary indexes: the Naming Speed Index (NSI) and Symbol Translation Index (STI). Meanwhile, in The Wechsler Preschool and Primary Scale of Intelligence Fourth edition WPPSI-IV, The Wechsler Adult Intelligence Scale-Fourth Edition WAIS-IV and The Wechsler Intelligence Scale for Children–Fourth Edition WISC-IV. The only five primary indexes are aligning with Gc, Gv, Gf, Gwm, and Gs, and This proved that there existed more factors present in the WISC-V than the previous Wechsler test editions.

Keywords: WAIS-IV, WISC-V, WPPSI-IV, CHC

1. Introduction

The development of intelligence scales has received great importance and effort by specialists to update with discoveries in intelligence since the appearance of the Binet - Simon scale several scales develop according to relevant theory with the field. The WAIS-IV, WISC-V, and WPPSI-IV tests of FSIQ are the three latest editions versions of most cognitive tests used in the world (Camara, Nathan, and Puente, 2000; Georgas, van de Vijver, Weiss, and Saklofske, 2003; Lichtenberger and Kaufman, 2009). These three tests are administered individually for adults, adolescents, and children. All Wechsler tests have been translated, adapted, and standardized in many countries. From the launch of the Wechsler Bellevue Intelligence Scale (WB) (Wechsler, D. 1939), this rich history of research and clinical applications without a doubt has contributed to the development of these three tests. From the creation of the Wechsler tests to the last edition are based on the g factor of Spearman, C. (1904). Thus, the developers of these tests stated that they use not only the General Intelligence factor but were also open to cognitive theories to guide for creation. We classified all subtests and complementary

indexes from the three tests of Wechsler of the USA version using the most recent Cattell-Horn-Carroll (CHC) theory is a comprehensive model of the major dimensions of individual differences that underlie performance on cognitive tests. This theory has been using to classify performance tests to facilitate the interpretation of academic abilities and to provide a basis for organizing assessments for those suspected of having a learning disability.

2. The Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV)

The Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) (WAIS-IV; Wechsler, 2008a, 2008b) designed to assess cognitive ability in individuals between the ages of 16–90 years. It includes 15 subtests, ten primary subtests (Similarities, Vocabulary, Information, Block Design, Matrix Reasoning, Visual Puzzles, Digit Span, Arithmetic, Coding, and Symbol Search) and five supplemental subtests (Comprehension, Figure Weights, Picture Completion, Letter-Number Sequencing, and Cancellation) designed to measure four positively intercorrelated indices: Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. Ten subtest scores are using to calculate the full-scale Intelligence Quotient (FSIQ), where there are three subtests from Verbal Comprehension (Similarities, Vocabulary; Information) and Fluid Reasoning (Block Design, Matrix Reasoning, Visual Puzzles) and two subtests from Working Memory (Digit Span, Arithmetic) and Processing Speed (Symbol Search, Coding).

3. The Wechsler Intelligence Scale for Children– Fifth Edition (WISC–V)

The Wechsler Intelligence Scale for Children–Fifth Edition (WISC–V) (WISC–V; Wechsler, 2014) is the test of cognitive ability for children for the age range from 6 years to 16 years 11 months. It consists of 16 subtests in USA version. Ten primary subtests are Similarities, Vocabulary, Block Design, Visual Puzzles, Matrix Reasoning, Figure Weights, Digit Span, Picture Span, Coding, and Symbol Search. More six supplementary subtests are Information, Comprehension, Picture Concepts, Arithmetic, Letter–Number Sequencing, and Cancellation. All subtests are designing to measure five scales Verbal Comprehension, Visual-Spatial, Fluid Reasoning, Working Memory, and Processing Speed; The Complementary Index is composing by three index scales: Naming Speed, Symbol Translation, and Storage and Retrieval calculated from (Naming Speed Literacy, Naming Speed Quality, Immediate Symbol Translation, Delayed Symbol Translation, and Recognition Symbol Translation). Complementary subtests aren't intelligence subtests and maybe not substituted for primary or supplementary subtests. And the hierarchically ordered full-scale Intelligence Quotient score (FSIQ) is composed by only seven primary subtests and not by ten subtests like the latest version of this test across to measure five scales: Verbal Comprehension (Similarities, Vocabulary), Visual Spatial (Block Design), Fluid Reasoning (Matrix Reasoning, Figure Weights), Working Memory (Digit Span), and Processing Speed (Coding).

4. The Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV)

The Wechsler Preschool and Primary Scale of Intelligence Fourth Edition (WPPSI-IV) (WPPSI-IV; Wechsler, 2012a, 2012b) for two age range, this test is devised in two editions, to measure the cognitive development of little children, The first one is for small age range between 2 years 6 months and 3 years 11 months, the second one is a big age range between 4 years and 7 years 7 months. Include 7 subtests composed of six primary subtests: Receptive Vocabulary, Information, Block Design, Object Assembly, Picture Memory, and Zoo Location, and one supplementary subtest is Picture Naming. All subtests are designing to measure three scales: Verbal Comprehension, Visual-Spatial, and Working Memory; For age between 4 years

to 7 years 7 months, includes 13 subtests, 10 primary subtests Information: Similarities, Block Design, Object Assembly, Matrix Reasoning, Picture Concepts, Picture Memory, Zoo location, Bug Search, Cancellation, plus three supplementary subtests: Vocabulary, Comprehension, and Animal Coding, All subtests are designing to measure five scales: Verbal Comprehension, Visual-Spatial, Fluid Reasoning, Working Memory, and Processing Speed. For the small age group of little children, the full-scale Intelligence Quotient for this age range is basing on five subtests: Information, Receptive Vocabulary, Block Design, Object Assembly, and Picture Memory. Finally, for the big age group, the full-scale Intelligence Quotient is based on six subtests: Information, Similarities, Block Design, Matrix Reasoning, Picture Memory, and Bug Search.

5. Cattell-Horn-Carroll (CHC) Theory

The CHC theory is widely used by psychologists to classify intelligence and performance batteries and neuropsychological tests. To facilitate interpretation of cognitive performance and provide a basis for organizing assessments for people suspected of having a disorder In 1993 by Carroll, this theory came together after several analyzes by legends in psychology over the previous 60 or 70 years regarding to the nature, identification, and structure of human cognitive abilities and it is divided into three hierarchical levels (Carroll, 1993). The third level is dominated by the general factor (g), which is a common factor between the tests after factorial analysis by Spearman, in 1927. But Thurstone in 1938 will question this one-dimensional design as it doesn't observe a general factor in his work; this proposes the existence of seven primary mental abilities factors are verbal fluency, verbal comprehension, spatial visualization, numerical ease, associative memory, reasoning, and speed of perception. In 1941 Raymond Cattell identified two factors of intelligence, the fluid intelligence, and the crystallized intelligence (Gf-Gc). But in 1965 John L. Horn developed this theory of his supervisor, Cattell, by an empirical study in his Ph.d .six factors in the first edition and fourteen factors by McGrew (2012) (quantitative knowledge (Gq), short-term memory (Gsm), visual processing (Gv), long-term memory (Glr), speed of treatment (Gs), Decision/Reaction Time/Speed (Gt), Reading and Writing Ability (Grw), Auditory Processing (Ga), Domain-specific knowledge (Gkn), Psychomotor ability (Gp), and Psychomotor speed (Gps), including tactile (Gh), kinesthetic (Gk), and olfactory (Go)) plus the two factors of Cattell-Horn (Gf-Gc) takes the second level in the theory of CHC which are then further subdivided into four come ten prime factors like induction (I), the development of the language (LD), lexical knowledge (VL) ... in The latest update of the CHC model by Schneider and McGrew (2012).

6. Classification and the Relation between WAIS-IV, WISC–V, And WPPSI–IV Subtests and their CHC Theory

The Wechsler tests are of top importance in the field of cognitive abilities tests since inspired from the Stanford-Benet scale and remain for the last seventy years the most used by psychologists and neuropsychologists working in schools, clinics, hospitals, universities and in forensic medicine. The latest American version of the Wechsler tests, since the creation of Wechsler, the manufacturers, indicates that the three tests basis is the g factor of Spearman. We compared the tests of Wechsler at the second level of the Cattell-Horn-Carroll theory (CHC). Recently, it has been using to classify performance tests to facilitate the interpretation of academic skills. It represents a basis for organizing assessments for people suspected of having a learning disability. These constructs of the Wechsler test include general intelligence and broad cognitive abilities such as fluid reasoning, verbal comprehension, short-term memory, visual processing, and processing speed. The CHC model of intelligence, general intelligence, and the broad cognitive abilities, may be interpreted to operate together within a system of interrelated cognitive abilities.

Table 1: Representation of broad CHC abilities on the three intelligence batteries of the Wechsler last edition.

Test	Fluid Reasoning (Gf)	Crystallized Intelligence (Gc)	Visual–Spatial Thinking (Gv)	Processing Speed (Gs)	Working Memory (Gwm)	Long-term Memory Retrieval (Glr)
WAIS IV	-Matrix Reasoning -Figure Weights	-Vocabulary -Similarities	-Block Design -Visual Puzzles	-Symbol Search -Coding	-Digit Span -Letter-Number Sequencing	
WISC V	-Matrix Reasoning -Picture Concepts -Figure Weight	-Vocabulary -Similarities -Comprehension	-Block Design -Visual Puzzles	-Symbol Search -Coding -Cancellation	-Digit Span -Letter-Number Sequencing [illegible]	-Immediate Symbol Translation -Delayed Symbol Translation
WPPSI IV	-Matrix Reasoning -Picture Concepts	-Vocabulary -Similarities -Comprehension	-Block Design -Object assembly	-Animal Coding -Bug Search -Cancellation	-Picture memory -Zoo Locations	

The table above shows the ranking of the subtests from the three Wechsler tests in the second level of the CHC theory. That the classification of subtests from the two age range of WPPSI together in the ranking for a small age range has just three-factor, and for a big age range have five-factor. Only in The WISC IV has just five factors but in the last edition six-factor that make sure the development of a new edition. Usually, the Wechsler tests consist of the same subtests, and in each trial, they according to the diverse age of the patients.

As a result, All subtests at the three Wechsler tests are classifying in five-factor skills: 1/ Fluid Reasoning Gf: mental ability to solve problems by applying new concepts or procedures, Gf has been linked to cognitive complexity which is typically defined as the greater use of a wide and diverse array of elementary cognitive processes during performance. Historically is often referred to as fluid intelligence.2/ Comprehension-knowledge Gc: the ability to recover, apply, and communicate this knowledge and skills acquired by a person and valued by his / her culture, Gc is primarily a store of verbal or language-based declarative (knowing what) and procedural (knowing how) knowledge acquired through the investment of other abilities during formal and informal educational and general life experiences. Historically is often referred to as crystallized intelligence. 3/ Working Memory Gwm: the capacity to memorize information a limited number of elements for a short time, 4/ Visual-Spatial Thinking Gv: the ability to analyze visual patterns and solve problems through the use of simulated mental imagery, 5/ Processing Speed Gs: the ability to perform repetitive and straightforward cognitive tasks quickly and fluently. (Flanagan et al., 2013).

But, besides, The WISC–V includes a storage and retrieval index (SRI) that is analogous to Long-term Memory Retrieval Glr: the capacity to retrieve easily information memorized for the long term, Some Glr narrow abilities have been prominent in creativity research (e.g., production, ideational fluency, or associative fluency). In the CHC theory, all factor proposed is linked together by the aptitude.

The developers of the Wechsler tests stated that for the creation of all new tests, they use current new development in cognitive, intellectual, and neuropsychological to guide to production, but also retain its link with the notion of Spearman general intelligence.

7. Conclusion

All David Wechsler tests are developed in his life and after his death. The edition of WISC V carries several changes to the level of construction, like the Full-Scale Intelligence Quotient (FSIQ) calculated by seven subtests. The Full-Scale Intelligence Quotient calculated in WAIS-IV and the WISC IV by ten subtests. The cognitive psychometric theory of CHC shows the classification of the sub-tests. The fourth edition of WAIS, WISC, and WPPSI measures five factors: Gc, Gv, Gf, Gwm, and Gs. The development of the fifth edition of WISC, with its six elements: Gc, Gv, Gf, Gwm, Gs, and Glr, has a link with the storage and retrieval index (SRI) and it also tests a few other factors when used with a measure of achievement. The factors are linked by subtests, which may have a high correlation between two elements. The subtest arithmetic correlates with Quantitative knowledge Gq which is a breadth and depth of a person's acquired reserve, quantitative or numerical declarative and procedural knowledge. It represents the stock of mathematical knowledge gained by an individual, not his reasoning. And Fluid Reasoning (Gf). This difference between Wechsler Bellevue and the last edition gives us legendary tests for school psychologists, clinical psychologists, and neuropsychologists working in schools, clinics, hospitals, universities, and forensics.

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