

## Improve Math – Session 4.11

### Woodcock-Johnson IV Cognitive Abilities Factor Clusters Influence on Achievement – Paul Nolting, Ph.D.

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The WJ-IV cluster scores have an average of 100 and a standard deviation of 15, meaning average scores are between 85 and 115. Scores between 100 and 85 are processing deficits causing learning problems. Scores below 85 are deficits causing major learning problems. Scores below 85 in Short-Term Working Memory, Long-term Memory and Fluid Reasoning may require substitutions.

#### **Auditory Processing**

Measures: Ability to work with auditory stimuli by putting together different sound patterns into words and evaluating between auditory patterns. The ability to discriminate, reason, remember during different tones and environmental sounds. Highly related to reading.

Relation to Math: Students may have difficulty reading the text and/or understanding lectures in a large or noisy classroom. Students may not understand vocabulary words or “miss” some of the lecture due to misplacing correct words with other words.

Example: The student asks the instructor to repeat information. They cannot listen while taking notes.

#### **Cognitive Processing Speed (visual)**

Measures: The student’s ability to rapidly scan and identify visual material such as letters, numbers, and objects.

Relation to Math: The student’s ability to understand mathematical symbols and numbers. It is the speed at which students can copy down recognizable numbers and symbols. Students may be slow in copying notes from the board and be slow in taking a math test. It is the fluency and automaticity of processing numbers, variables, and math symbols. This cluster is correlated to math success.

Example: The student cannot keep up when taking notes, slower in doing homework, and may not finish tests. The student may take an extremely long time reading a math textbook that is “busy” in appearance or may not read it at all.

#### **Short-Term Working Memory (auditory & visual)**

Measures: Evolved from Short-term Memory and now the two terms are sometimes used interchangeably. The student’s ability to recall, maintain and manipulate information in current attention. It is a temporary storage of current and recalled auditory and visual information that is the mind’s dynamic “work area” allowing information to be processed and worked on. It is like RAM in a computer.

Relation to Math: The student’s ability to recall oral or visual lecture information in the correct order and to work on that problem using current and recalled knowledge. A student listens to a math instructor explain steps but forgets the steps or writes the steps in the wrong order. Students cannot hold or recall the information to solve problems. This cluster highly correlates with math success.

Example: The student may have difficulty reading the textbook. Student may have incomplete notes causing problems with homework. Student may have difficulty with understanding mathematical concepts, remembering formulas long enough to get in their notes and during tests may have a limited amount of “space” to “hold” information and concepts to solve problems.

## Visual Processing

Measures: The student's ability to discriminate, remember different visual designs to be used in solving problems.

Relation to Math: The student's ability to recognize and remember in sequence, complex mathematical symbols and numbers that may be unfamiliar. Students may copy material incorrectly from the board. Students may have difficulty reading the text and tests.

Example: Students may take very few notes. Student spends most of his/her time concentrating on taking notes and misunderstands the instructor. Has number reversals or transposes part of an equation. May solve the problems correctly based on how they wrote it down but is told it is incorrect because they did write it down incorrectly. Notes cannot be read because it looks like chicken scratch.

## Long-Term Storage and Retrieval

Measures: The student's ability to store and recall information for minutes, hours, days, or years. It measures the volume, and accuracy of information held in active memory that comes through short term working memory to long-term memory and abstract reasoning and the recalling of that information. It is a learning gateway and like a computer's processing speed and bandwidth.

Relation to Math: The student's fluency to store and retrieve math information learned during lectures and tutoring. It acts like a portal for information resources such as arithmetic facts, formulas, vocabulary, recognizing several types of problems, algorithms, and heuristics. Students' inability to recall many steps to a problem to understand the concept or to recall enough facts to help solve the problem. This cluster is related to Dyscalculia which is an arithmetic disorder.

Example: Students are inconsistent in solving problems. May recall some of the steps to the problem but not all of them. Students have difficulty storing or recalling multiplication facts, formulas, and concepts that are necessary to solve problems.

## Comprehension –Knowledge (long-term memory)

Measures: The student's acquired knowledge; the ability to comprehend and communicate that knowledge and the ability to reason using previously learned experiences. This is primarily declarative and procedural language-based knowledge that is stored in memory.

Relation to Math: The student's ability to access long-term memory for mathematics formulas, math vocabulary, math properties, math facts such as multiplication tables, and to remember rote steps to solve math problems. Highly correlated with math success.

Example: Students are inconsistent in remembering math facts such as how to add mixed numbers, reduce fractions, the distributive property, rules of adding multiplying like terms with exponents. Students may understand how to work the problem (concept), forget the steps but when shown again can solve similar problems.

## Fluid Reasoning (abstract reasoning)

Measures: The student's nonverbal abstract reasoning and problem solving skills such as induction and quantitative reasoning.

Relationship to Math: The student's ability to understand abstract mathematics formulas/concepts and generalize the formulas/concepts to solve homework and test problems. Has difficulty verbalizing what has been learned and difficulty understanding the instructor's repeated explanation. Best predictor for math success, however, may not be improved.

Example: Students may remember the rule but cannot use it to solve homework problems. Student is confused about the rule and does not understand what rule applies to which problems. Students are shown how to solve the problem several times but still cannot solve it.

## **Other Useful Clusters**

Quantitative Reasoning: The student's ability in quantitative, nonnumeric, and algorithmic reasoning. Measures a student's ability to understand math concepts and generalize the concepts. Highly correlated with math success.

Cognitive Efficiency: The student's speed and efficiency to cognitively process information automatically. For example, a student's visual/auditory speed in processing numbers and symbols.