

# Fluid Reasoning (Also known as Fluid Intelligence)

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## INSTRUCTIONAL IMPLICATIONS OF WEAKNESSES IN BASIC PSYCHOLOGICAL PROCESSING ABILITIES

This document is intended to help staff link patterns in achievement with weaknesses in basic psychological processes. Information in this document should be helpful to teams in determining existing and future difficulties in achieving proficiency with academic standards. Instructional implications may apply to a wide range of students and users may find redundancy and overlap in recommendations.

### Cautions in Using this Document:

- Be aware that students who are acquiring English Language Skills may present as having processing difficulties. Teams will need to have expertise in differentiating disability from language acquisition to prevent from over-identifying students.
- Be aware that students who are presenting with emotional difficulties, brain injury, or taking certain medications, have a history of trauma may present with weaknesses in cognitive processing. This document may be helpful in planning instruction; however, should not be used to determine/reclassify the student as having a SLD eligibility.

## Fluid Reasoning (Also known as Fluid Intelligence)

### Fluid Reasoning Abilities

**Definition:** Ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures. These processes are minimally dependent on learning and acculturation; however, a student would need an amount of knowledge in order to manipulate rules; make deductions, inductions, and predictions; draw inferences; answer critical thinking questions; interpret graphs or charts; apply problem solving skills.

**Remediable:** No. However, accommodations, assistive technology, and differentiated instruction will provide student greater access to content. Quantitative reasoning, which is subsumed within fluid reasoning, is more directly related to formal instruction, and is measured as both fluid intelligence and academic abilities and therefore may be impacted by related experiences.

**Related areas of processing:** gaining awareness of information (attention) and holding different aspects of information in the span of awareness (working memory), both of which are dependent on a capacity for maintaining concentration.

**Impacts:** All academic areas. Normative weakness implies general learning difficulty as reasoning abilities are required for all academic areas. Specific difficulties include use of less effective strategies for task completion and rigid cognitive style. Any academic content area that requires forming and recognizing concepts, identifying and perceiving relationships, drawing inferences, and reorganizing or transforming information “problem solving”, deriving solutions to new or novel problems (mental flexibility), extending knowledge through critical thinking. Although inductive and general sequential reasoning abilities play a moderate role in reading comprehension, deductive (general to specific thinking) and inductive (specific to general thinking) are consistently very important in math (especially math reasoning) at all ages. Inductive and general sequential reasoning abilities is related to basic writing skills primarily during the elementary school year (e.g., 6 to 13) and consistently related to written expression at all times.

### **Impacts cont:**

More targeted areas of academic impact follow and should be useful in interpreting student work samples, observations, teacher interview, and test results.

### **READING Achievement**

- Inferential comprehension.
- Finding the main idea.
- Finding relationships: compare and contrast, fact vs. opinion.
- Inductive and general sequential reasoning play a moderate role in reading comprehension

### **MATH Achievement**

- Internalizing procedures and processes used to solve problems, knowing when and how to apply them to novel problems and relationships between numbers.
- Inductive and general sequential reasoning are very important at all ages.

### **WRITING Achievement**

- Developing a theme.
- Creating passages that illustrate relationships between ideas such as compare and contrast, fact.
- Inductive and general sequential reasoning are related to basic writing skills primarily during elementary years and consistently related to written expression at all ages.

### **Additional Indicators across other environments and contexts**

- **At home, with peers, in the community**
- **Observed behaviors during assessment**
- **Other indicators in performance or vocational readiness**

### Research-based Implications for Instruction, Curriculum, Environment (ICE)

#### Instruction:

- Develop student's skills in categorizing and drawing conclusions. Use hands on, familiar vocabulary, and graphic organizers to explicitly teach the thinking skill of categorizing, similarity, difference, etc. Students must become automatic in the use of these tools in order to apply them to new and novel concepts or content. The Content Enhancement and Strategic Instruction Model strategies are research-based strategies for teaching thinking and using graphic organizers.
- Use graphic organizers to make relationships between words, objects, concepts, etc. visual and more concrete.
- Explicitly teach text structure, story grammar, print cues, story mapping, etc. to increase understanding of organization.
- Teach linking words (anaphors or mortar words) and other cues to assist in finding sequences, key points, etc.
- Use demonstrations or think-a-louds to externalize reasoning processes. Strategies such as reciprocal teaching, cooperative learning, study buddies, and modeling thinking will only work if the student who is the tutor has intact reasoning and communication abilities. The learner has to see the thinking that is going on for this strategy to work.
- Provide specific and concrete feedback. Steps in providing feedback must include acknowledgement of what was done correctly, specification of where things went wrong, what needed to happen or how to correct the mistakes, and an opportunity to practice with guidance immediately afterward. The direct instruction method provides the best example of how to provide specific and concrete feedback.
- Teach, recognize, and reward use of meta-cognitive strategies to monitor both comprehension and thinking skills.
- Provide tasks which require peers and modeling of thinking when comparing and contrasting, classifying, inducing, deducing, abstracting and analyzing perspectives.
- Provide experiential learning experiences. Instruction that combines physical activities with problem solving tasks. Provide opportunities to develop meta-cognitive strategies and higher order skills. Engaging in reflective discussions about the lessons or using thought journals.
- Teach students to use self-questioning techniques, identifying main ideas and themes, classify and categorize objects, attend to organizational cues, and implement strategies which support inferential skills.

**Curriculum:** Select evidence-based materials that use concrete examples, scaffold thinking skills within the content, make use of graphic organizers and provide teachers with guidance on how to support critical thinking through questioning and use of feedback. In cases where reasoning abilities are significantly below average the curriculum may need to be reduced in depth and complexity. The essential ideas and understandings must be prioritized and taught to mastery.

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**Environment:** Recognize and reward modeling and explaining thinking. Have peers focus on the how and why not just the answer. Establish routines and opportunities to use hands on materials and visuals throughout the grades.

**Recommendation for Differentiation in the General Classroom:** (includes changes in methods, UDL , process, accommodations, assistive technology, etc.)

Content	Process	Product
<p>Use research-based strategies for organizing and teaching such as those produced by University of Kansas e.g. Content Enhancement Routines: ( teaching routines for planning &amp; leading learning; routines for exploring text, topics, details; routines for teaching concepts).</p> <p>Provide examples to make abstract concepts more concrete use visuals to make conceptual information concrete.</p> <p>Make word problems applicable to real life experiences or prior experiences.</p> <p>Teach thinking skills as part of content.</p>	<p>Provide multiple opportunities to scaffold thinking and use of higher order thinking skills.</p> <p>Make the abstract real by using hands on practice, real objects, experiential or problem based learning</p> <p>Explicitly and systematically teach problem solving strategies and flexible thinking skills through modeling, and guided practice with specific feedback.</p> <p>Use peer tutors, and reciprocal teaching strategies to model thinking and approaches to problem solving.</p> <p>Use review and repetition to promote transfer.</p> <p>Teach strategies that will develop the students' meta-cognitive abilities.</p> <p>Use paper and electronic graphic organizers to find and show relationships.</p> <p>Student use of auto-summarizing software and highlighted notes to identify main points and key vocabulary to aid in text comprehension.</p>	<p>Provide model of end product</p> <p>Encourage use of manipulatives</p> <p>Use of paper and electronic graphic organizers and outlining tools for use in brainstorming organizing ideas.</p> <p>Use of pre-writing organizers and checklists to guide students through the writing process.</p>

### Implications for Achieving Proficiency on State Standards

Samples of English Language Arts content standards, if unsupported, may exceed a student's reasoning capacities or compensatory strategies which in turn will decrease the likelihood of reaching proficiency and transferring learning to new situations:

- Grade 2 Language Standards: generalize learned spelling patterns when writing words.
- Grade 4 Language Standards: recognize and explain the meaning of common idioms, adages, and proverbs.
- Grade 5 Speaking, Viewing, Listening, Media Standards: summarize the points a speaker makes and explain how each claim is supported by reasons and evidence distinguishing between the speaker's opinions and verifiable facts.
- Grade 5 Language Standards: Use knowledge of language and its conventions when writing, speaking, reading, or listening to expand, combine, and reduce sentences.
- Grade 5 Reading Standards for Informational Text: Explain the relationships of interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- Grade 8 Reading Standards for Informational Text: Analyze how a text makes connections among and distinctions between individuals, ideas, or events (e.g. through comparisons, analogies or categories)
- Grad 9-10 Reading Standards for Informational Text: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.

Sample of Mathematics content standard, if unsupported, that may exceed a student's working memory capacities or compensatory strategies:

- Grade 3 Estimate products and quotients of multi-digit whole numbers by using rounding, benchmarks and place value to assess the reasonableness of results.
- Grade 4 Round decimals to the nearest tenth.
- Grade 5 Order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.
- Grade 6 Use reasoning about multiplication and division to solve ratio and rate problems.

### Resources and References Linking Fluid Reasoning with Achievement

Benson, N., Hulac, D., & Kranzler, J. (2010). Independent examination of the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV): What does the WAIS-IV measure? *Psychological Assessment, 22* (1), 121-130.

Berninger, V. and Richards, T. (2002). *Brain literacy for educators*. Academic Press. San Diego, CA.

Burgess, G., Gray, J., Conway, A., & Braver, T. (2011). Neural mechanisms of interference control underlie the relationship between fluid intelligence and working memory span. *Journal of Experimental Psychology, 140* (4), 674-692.

Decker, S. L., Hill, S. K., & Dean, R. S. (2007). Evidence of construct similarity in executive functions and fluid reasoning abilities. *International Journal of Neuroscience, 117*(6), 735-748.

Dehn, M. (2006). *Essentials of processing assessment*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Feifer, S. and De Fina, P. (2005). *The neuropsychology of mathematics: Diagnosis and intervention*. School Neuropsych Press.

Feifer, S. and De Fina, P. (2002). *The neuropsychology of written language disorders: Diagnosis and intervention* School Neuropsych Press Inc.

Feifer, S. and De Fina, P. (2000). *The neuropsychology of reading disorders: Diagnosis and intervention*. School Neuropsych Press Inc.

Ferrer, E., McArdle, J. J., Shaywitz, A., Holahan, J. M., Marchione, K., & Shaywitz, S. E. (2007). Longitudinal models of developmental dynamics between reading and cognition from childhood to adolescence. *Developmental Psychology, 43*(6), 1460-1473.

Flanagan, D.P., and Alfonso, V.C. (2011). *Essentials of Specific Learning Disability Identification*. Hoboken, New Jersey, John Wiley & Sons.

Flanagan, D.P. and Kaufman, A. S. (2004). *Essentials of WISC-IV assessment*. Hoboken, New Jersey, John Wiley & Sons.

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---

- Flanagan, D.P., Ortiz, S.O. Alfonso, V.C. (2007). *Essentials of cross battery assessment*, Second Edition. Hoboken, New Jersey, John Wiley & Sons.
- Fletcher, J. Lyon, R. Fuchs, L. & Barnes, M. (2006). *Learning disabilities from identification to intervention*. New York: Guilford Press.
- Fletcher-Janzen, E. (July 10, 2008). *Neuroscientific contributions to the determination of learning disabilities in the era of RTI*. Conference proceedings and personal communications from the Third National *School Neuropsychology Conference, Dallas, Texas*.
- Floyd, R. G., Keith, T. Z., Taub, G. E., & McGrew, K. S. (2007). Cattell-Horn-Carroll cognitive abilities and their effects on reading decoding skills: g has indirect effects, more specific abilities have direct effects. *School Psychology Quarterly*, 22(2), 200-233.
- Fry, A., & Hale, S. (1996). Processing speed, working memory, and fluid intelligence: Evidence for a developmental cascade. *Psychological Science*, 7 (4), 237-241.
- Geary, D. C., Hoard, M. K., & Bailey, D. H. (2011). *How SLD manifests in mathematics*. In Flanagan, D. P., & Alfonso, V. C. (Eds.), *Essentials of Specific Learning Disability Identification* (pp. 43-64). Hoboken, New Jersey: Wiley & Sons.
- Hale, J., and Fiorello, C. (2004). *School neuropsychology: a practitioner's handbook*. New York: Guilford Press.
- Lassiter, K., Harrison, T., Matthews, D., & Bell, N. (2001). The validity of the comprehensive test of nonverbal intelligence as a measure of fluid intelligence. *Assessment*, 8 (1), 95-103.
- Mascolo, J. (2010). *Cognitive functioning: Identifying, understanding, and addressing the impact of cognitive deficits in the classroom* (PowerPoint) St. Johns University
- Mascolo, J. (2009). *Minnesota department of education cross-battery pilot staff cognitive processing Webinar* (parts 1-2).
- McArdle, J. J., Ferrer-Caja, E., Hamagami, F., & Woodcock, R. W. (2002). Comparative longitudinal structural analyses of the growth and decline of multiple intellectual abilities over the life span. *Developmental Psychology*, 38(1), 115-14.



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---

McGrew, K. (July 10, 2008). Advances in the prediction of academic achievement using WJIII cognitive subtests. Conference proceedings and personal communications from the Third National *School Neuropsychology Conference, Dallas, Texas*.

Mogle, J., Lovett, B., Stawski, R., & Sliwinski, M. (2008). What's so special about working memory?: An examination of the relationships among working memory, secondary memory, and fluid memory. *Psychological Science, 19* (11), 1071-1077.

Reynolds, M. R., Keith, T. Z., Fine, J., Fisher, M. E., & Low, J. A. (2007). Confirmatory factor structure of the Kaufman Assessment Battery for Children--Second Edition: Consistency with Cattell-Horn-Carroll theory. *School Psychology Quarterly, 22*(4), 511-539.

Schwartz, D. (2008). **Memory and Learning and Implications for Instruction**. Conference proceedings and personal communications from the Third National *School Neuropsychology Conference, Dallas, Texas*.

Shelton, J. T., Elliott, E., Matthews, R., Hill, B., & Gouvier, W. D. (2010). The relationship of working memory, secondary memory and general fluid intelligence: Working memory is special. *Journal of Experimental Psychology, 36* (3), 813-820.

Taub, G. E., Keith, T. Z., Floyd, R. G., & McGrew, K. S. (2008). Effects of general and broad cognitive abilities on mathematics achievement. *School Psychology Quarterly, 23*(2), 187-198.

Wallach, G. P. (2007). *Language Intervention for School-Age Students: Setting Goals for Academic Success*. Mosby Elsevier Health Sciences.

Wendling, B. and Mather, N. (2008). *Essentials of Evidence-Based Academic Interventions*. Hoboken, New Jersey, John Wiley & Sons.

Wodrich, D. & Schmitt, A. (2006) *Patterns of Learning Disorders: Working Systematically from Assessment to Intervention* New York: The Guilford Press.

Wright, S., Matlen, B., Baym, C., Ferrer, E., & Bunge, S. (2008). Neural correlates of fluid reasoning in children and adults. *Frontiers in Human Neuroscience, 1*(8), 1-8.

