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Riverside

Cognitive Abilities Test™ Form 7

A Short Guide for Teachers

From Profiles to Practice:
A Resource Guide for the Classroom Teacher

CogAT®

March 2013

PART 1

Basic Information about the *Cognitive Abilities Test* ™

Purpose of the Test

Form 7 of the *Cognitive Abilities Test (CogAT)* appraises the level and pattern of verbal, quantitative, and spatial (nonverbal) reasoning abilities for students from kindergarten through grade 12. These abilities reflect the overall efficiency of cognitive processes and strategies that enable individuals to learn new tasks and solve problems. Because these abilities are closely related to an individual's success in school in virtually all subjects, *CogAT* test results are helpful in planning effective instructional programs and adapting instruction in ways that enhance the student's chances of success in learning.

Structure of the Test

CogAT Form 7 has adopted new age-based level designations that are aligned with the *Iowa Assessments™ Form E.* Each of the three batteries – Verbal, Quantitative, and Nonverbal – has three subtests. The abilities appraised are those that enable students to acquire, organize, store in memory, and recall information; to make inferences; to detect relationships; to comprehend and analyze problem situations; to form concepts; to discover and remember sequences; to recognize patterns; to classify or categorize objects, events, and concepts; to infer rules and principles; and to relate and use previous experience to accomplish new learning tasks or solve novel problems. All three of the batteries have been designed to appraise general inductive and deductive reasoning abilities and also specific reasoning abilities that are unique to the battery.

Figure 1: Subtests by Battery

Verbal Reasoning	Quantitative Reasoning	Nonverbal Reasoning .....
Verbal (Picture) Analogies Sentence Completion Verbal (Picture) Classification	Number Analogies Number Puzzles Number Series	Figure Matrices Figure Classification Paper Folding

Form 7 for Grades K–2 (Levels 5/6–8)

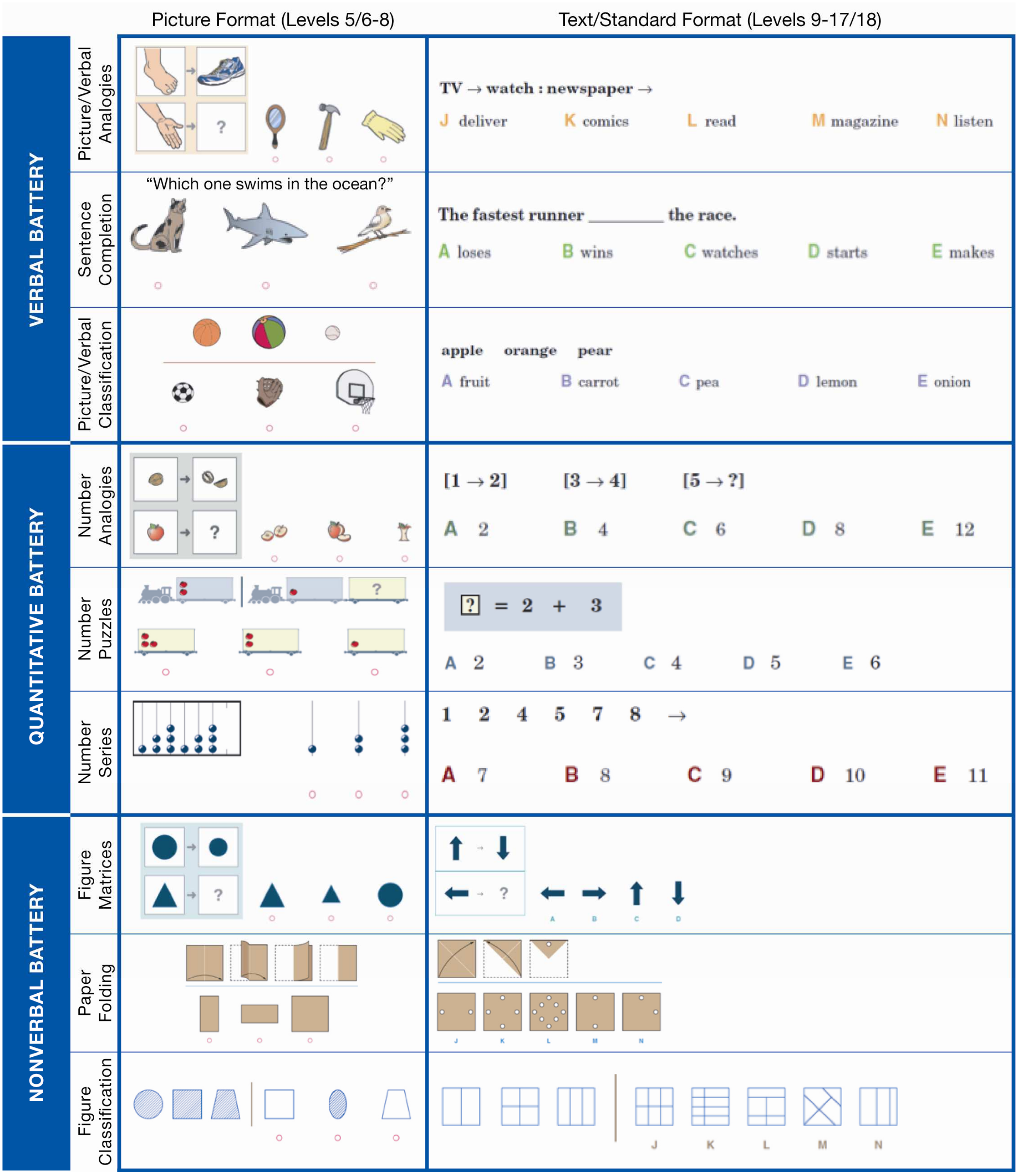
Levels 5/6, 7, and 8 of *CogAT* Form 7 are designed for students in kindergarten through second grade. The questions in each battery are divided into three subtests, each of which has a different item format. (See the sample items in Figure 2). No reading is required on the part of the student. All directions are read aloud by the test administrator, who also paces students through the test so that they do not rush heedlessly or labor needlessly.

In the Verbal Battery, the Picture Analogies test and the Picture Classification test are comprised of all picture-based questions that measure verbal reasoning processes without tying questions to a specific administration language. The Sentence Completion test is the only subtest that requires teacher-read prompts. On this test, the test administrator reads a question in English and/or Spanish and the students choose the picture that best answers the question. The Sentence Completion test can be omitted or not scored for bilingual children who do not speak English or Spanish.

The Quantitative Battery consists of three subtests that have been adapted for young students by couching quantitative reasoning challenges in engaging and accessible formats. The Number Analogies test for primary-grade students relies on picture-based quantitative concepts rather than numeral representations. The Number Puzzles test presents equations as two trains which must carry the same number of objects. And the Number Series test is presented as an abacus toy in which students search the beads looking for patterns. All of these formats have been extensively tried out with students and found to be engaging and to tap into important quantitative reasoning skills.

The three subtests on the Nonverbal Battery at the lower levels are just like those at the upper levels and did not require much adaptation for young students. The Figure Matrices test contains three figures in an analogy (A→B: C→?) that the student must complete. The Paper Folding test requires students to determine how a folded, hole-punched paper will appear when it is unfolded. The Figure Classification test presents three figures in the stem, and the student chooses the fourth figure that belongs to the set.

Figure 2: Item Formats Implemented in *CogAT* Form 7



Form 7 for Grades 3–12 (Levels 9–17/18)

Levels 9–17/18 of *CogAT* Form 7 are designed for students in grades 3 through 12. Level 9 transitions from the picture-based, teacher-paced, verbal and quantitative subtests used with students in grades K–2 to the text- and numeric-based, timed, verbal and quantitative subtests used at the upper grades. Children are allowed to pace themselves through each test, which all have a 10 minute time limit. The student must read individual words on two subtests in the Verbal Battery (the Verbal Analogies test and the Verbal Classification test) and a sentence in the third (the Sentence Completion test). The three subtests in the Quantitative Battery are the Number Series test, the Number Analogies test, and the Number Puzzles test. The first two formats are commonly used on ability tests. The latter is a novel format that requires students to determine the values of one or more geometric shapes that make a simple equation true. The three subtests of the Nonverbal Battery are the Figure Matrices test, the Paper Folding test, and the Figure Classification test, which were all described above for the Levels 5/6, 7, and 8 tests.

Using the Test Results

The three primary uses of *CogAT* scores are (1) to guide efforts to adapt instruction to the needs and abilities of students, (2) to provide a measure of cognitive development, and (3) to identify students whose predicted levels of achievement are markedly discrepant from their observed levels of achievement. A brief discussion of each use follows.

The first and most important use of *CogAT* scores is to help teachers adapt instructional goals, methods, and materials to the individual needs of students. Part 3 of this guide explains how to make principled adaptations of instruction and discusses why *CogAT* scores are especially useful for guiding this process. Part 4 offers specific suggestions for building on student's strengths, Part 5 for shoring up weaknesses, and Part 6 for assisting students with mixed ability profiles that have both significant strengths and weaknesses.

The second use of *CogAT* is to provide a measure of each student’s level of cognitive development that captures important information not represented in school grades or in other measures of school achievement. For example, *CogAT* scores help identify academically gifted students. Less than half of the students who score in the top 3 percent on the *Iowa Assessments*® also score in the top 3 percent on *CogAT.* This means that *CogAT* will identify many students as academically gifted who would not be identified on the basis of academic achievement alone. Conversely, the profile of *CogAT* scores show that most low-achieving students are able to reason at higher levels than their academic performance suggests. In fact, the lower the students’ scores on an achievement test, the greater the probability that their *CogAT* scores will be at significantly higher levels.

The third use of *CogAT* scores is to identify students whose levels of academic achievement are substantially lower or higher than expected given their *CogAT* scores. Students whose achievement is markedly below expectations should be checked for other problems such as learning disabilities, poor vision or hearing, the need for more assistance in completing school lessons, or the need for a different instructional program. On the other hand, students whose academic performance is better than would be expected from their *CogAT* scores should also be looked at more carefully. These students have learned well the specific skills taught in school but are less successful in solving unfamiliar problems. Such students might profit from tasks that emphasize transfer and innovation.

Understanding Ability Profiles

A *CogAT* composite score provides the average of a student's scores on the three *CogAT* batteries. However, the ability profile is a far more informative and useful index. The ability profile captures two characteristics of the student's scores:

- level – the typical magnitude of scores on the three batteries
- pattern – whether some scores are significantly higher or lower than other scores

Score Levels

A **stanine** indicates one of nine broad score groupings on a normalized standard score scale. Stanines range from 1 (lowest) to 9 (highest). See Table 1.

Each *CogAT* ability profile begins with a number that represents the student's **median age stanine.** For example, if the student has age stanines of 6, 3, and 8 on the Verbal, Quantitative, and Nonverbal Batteries, respectively, the student's median age stanine is 6 (the middle of the student's three age stanines).

In a student's ability profile, the median age stanine indicates a level of reasoning ability. It is often useful to describe a student's *CogAT* results in terms of one of the reasoning ability levels shown in the table below rather than in terms of the stanine number.

Table 1: Median Age Stanine by Reasoning Ability Level

Median Age Stanine	Reasoning Ability Level
9	Very high
7–8	Above average
4–6	Average
2–3	Below average
1	Very low

Score Patterns

The graph of a student's score for each *CogAT* battery includes an estimate of the margin of error, displayed on the score report as a confidence band (shaded rectangle) around the age percentile rank (APR) score for each of the three batteries. These margins of error vary by battery and student. Unusually wide confidence bands indicate that the student's scores on the subtests or items in the battery were inconsistent and so the score on the battery probably should not be used. The profile is then also suspect.

Based on the relative position of these confidence bands, ability profiles are classified as A, B, C, or E profiles. The *List of Student Scores* excerpts that follow show examples of these profiles and their confidence bands.

In an **A** profile, all three confidence bands overlap, meaning the student's Verbal, Quantitative, and Nonverbal Battery scores are roughly at the s**A**me level. About one-third of students have this profile.

CogAT®

LIST OF STUDENT SCORES
Cognitive Abilities Test™ (CogAT®)

Class: Ness
Building: Longfellow
District: Dalen Community
System: System 1
Region: Region 1
State: State 1
Form-Level: 7-9
Test Date: 10/2011
Norms: Fall 2011
Grade: 3
Page: 1

STUDENT NAME / I.D. Number 1 / I.D. Number 2 / ABCDEF G H I J K L M NOPZ	Birth Date Level (Gender) / Age Form / Program		No. of Items	No. Att	Raw Score	USS	AGE SCORES SAS	AGE SCORES PR	AGE SCORES S	GRADE SCORES PR	GRADE SCORES S	LOCAL SCORES PR	LOCAL SCORES S	Student Profile APR Graph (1 10 25 50 75 90 99)	Ability Profile
Delgado, Cira	12/03 9 (F)	Verbal	62	62	47	210	114	81	7	89	8	88	7	81	6A
0000152607	09-02 7	Quantitative	52	52	36	204	111	75	6	85	7	86	7	75	
		Nonverbal	56	56	38	208	110	73	6	81	7	85	7	73	
		Composite (VQN)				**207**	**112**	**77**	**7**	**87**	**7**	**87**	**7**		

In a **B** profile, two of the confidence bands overlap. The third score is a relative strength or weakness, significantly a**B**ove or **B**elow the other two. About 42 percent of students have a **B** profile.

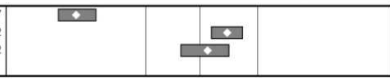
STUDENT NAME / I.D. Number 1 / I.D. Number 2 / ABCDEF G H I J K L M NOPZ	Birth Date Level (Gender) / Age Form / Program		No. of Items	No. Att	Raw Score	USS	AGE SCORES SAS	AGE SCORES PR	AGE SCORES S	GRADE SCORES PR	GRADE SCORES S	LOCAL SCORES PR	LOCAL SCORES S	Student Profile APR Graph (1 10 25 50 75 90 99)	Ability Profile
Bagsby, Aiden	04/04 9 (M)	Verbal	62	62	39	193	107	67	6	67	6	75	6	67	4B (V+)
0000147548	08-06 7	Quantitative	52	52	21	178	94	35	4	33	4	44	5	35	
		Nonverbal	56	56	25	179	93	33	4	30	4	40	4	33	
		Composite (VQN)				**183**	**97**	**43**	**5**	**41**	**5**	**53**	**5**		

In a **C** profile, two scores Contrast. The student shows a relative strength **and** a relative weakness. About 14 percent of students have a **C** profile.

STUDENT NAME / I.D. Number 1 / I.D. Number 2 / ABCDEF G H I J K L M NOPZ	Birth Date Level (Gender) / Age Form / Program		No. of Items	No. Att	Raw Score	USS	AGE SCORES SAS	AGE SCORES PR	AGE SCORES S	GRADE SCORES PR	GRADE SCORES S	LOCAL SCORES PR	LOCAL SCORES S	Student Profile APR Graph (1 10 25 50 75 90 99)	Ability Profile
Gambosi, Olivia	06/04 9 (F)	Verbal	62	62	26	174	93	33	4	27	4	41	5	33	5C (V-Q+)
0000146921	08-04 7	Quantitative	52	52	27	186	104	60	6	54	5	70	6	60	
		Nonverbal	56	56	30	188	102	55	5	53	5	63	6	55	
		Composite (VQN)				**183**	**99**	**48**	**5**	**41**	**5**	**53**	**5**		

An **E** profile indicates Extreme score differences. At least two scores differ by 24 or more points on the standard age score (SAS) scale. About 10 percent of students have an **E** profile.

STUDENT NAME I.D. Number 1 I.D. Number 2 ABCDEF G H I J K L M NOPZ	Birth Date Age Program	Level Form	(Gender)		No. of Items	No. Att	Raw Score	USS	AGE SCORES SAS	PR	S	GRADE SCORES PR	S	LOCAL SCORES PR	S	Student Profile APR Graph (1, 10, 25, 50, 75, 90, 99)	Ability Profile
Perez, Estavan 0000139927	10/03 09-00	9 7	(M)	Verbal	62	62	18	163	76	7	2	9	2	15	3	7	5E (V-)
				Quantitative	52	52	32	195	105	62	6	73	6	70	6	62	
				Nonverbal	56	56	33	195	101	52	5	61	6	57	5	52	
				Composite (VQN)				**184**	**92**	**31**	**4**	**43**	**5**	**63**	**6**		



Relative Strengths and Weaknesses

An ability profile also indicates any relative strengths and/or weaknesses evident in the student's battery scores.

+	V, Q, or N followed by a plus sign (+) indicates a relative strength on the Verbal, Quantitative, or Nonverbal Battery, respectively.
–	V, Q, or N followed by a minus sign (–) indicates a relative weakness on the Verbal, Quantitative, or Nonverbal Battery, respectively.

For example, an ability profile of **4B (V+)** means that the student's median age stanine is 4 and that the student's score on the Verbal Battery was significantly higher (aBove) than the student's scores on the two other batteries.

Ability Profile Examples

A variety of ability profiles are explained in the examples below.

9A	Very high scores on all three batteries
8B (Q–)	Generally high scores but a relative weakness on the Quantitative Battery
2B (N+)	Generally below-average scores but a relative strength on the Nonverbal Battery
5C (V+ N–)	Generally average scores but a relative strength on the Verbal Battery and a relative weakness on the Nonverbal Battery
8E (V–)	Generally high scores but an extreme relative weakness on the Verbal Battery

In general, the number (the median age stanine) carries the most information in the interpretation of **A** profiles, less for **B** profiles (now we must also consider the strength or weakness), still less for **C** profiles (because we must consider a strength *and* a weakness), and the *least* information for **E** profiles.

PART 2

Adapting Instruction to Individual Differences

Adapting instructional methods in order to meet the unique needs of each student has long been a goal of thoughtful teachers. A substantial body of research exists to guide decisions of how best to educate different students. However, very little of this information has found its way into curriculum guides and other materials that teachers use. Following is a review of some of these general principles for adaptation of instruction, beginning with some common myths about instructional adaptation.

Common Myths about Adapting Instruction

Myth 1: All Students Are Pretty Much Alike. Although few educators would agree with this statement, many well-meaning but uninformed educational policies presume it to be true. While few educators would agree with such a statement, those who assert that there is one best way to teach science, mathematics, or reading assume it to be true. On occasion the presumption stems from a failure to appreciate the range of individual differences that teachers must accommodate in their classrooms. For example, it is not uncommon for students in a class to differ by 4 or more grades in achievement levels.

The belief that all students are the same ignores these individual differences and their implications for instruction. What is good for the least-able student is assumed to be good for the most-able student or vice versa. What works for the student who reasons well with images but poorly with words is assumed to be just as effective for the student with the opposite profile.

Myth 2: Every Student Is Unique. Those who do not subscribe to Myth 1 sometimes subscribe to the opposite myth—namely, that every student is unique. It is helpful to keep in mind that, in some respects, every student is like *all* other students, like *some* other students, and like *no* other student. Generalizations about teaching and learning are possible only to the extent that the first and second statements hold. If every student is considered unique, then no generalizations can be offered. A good educational program, then, is faithful to all three aspects—the universality, the commonality, and the uniqueness of each student.

Myth 3: Adaptations Should Be Based on Self-Reported Learning Styles. The third myth is that effective instructional adaptations should be based on students self-reported learning styles. When educators refer to a student's "learning style," they typically imply something about the student's ability to reason in a particular symbol system. Since Thurstone (1938), however, psychologists have measured specific abilities by making the tests that measured them as independent of each other as possible. Unfortunately, to accomplish this, it was necessary to reduce as much as possible the demands for reasoning. For example, spatial ability was measured by how rapidly test-takers could mentally rotate simple images, not by how well they could reason using visual imagery. When abilities were measured in this way, investigators repeatedly discovered that it didn't seem to matter much whether instructional methods matched the profile of each student's abilities. Rather, it was an estimate of the student's reasoning ability that routinely moderated the effectiveness of different instructional methods.

Questionnaires that label students as "visualizers" or "verbalizers" or as "auditory learners" or "visual learners" may be helpful in assisting students to understand themselves better, but such measures have not proven useful for helping teachers adapt their teaching methods and materials in ways that help more students succeed. Rather, the critical information for understanding how students learn is given by the profile of their reasoning abilities. Because of this, the profile of reasoning scores on *CogAT* provides a measure of learning style that actually works.

Myth 4: If the Method Is Right, the Outcome Will Be Good. Another myth is that if we somehow knew more, we would be able to specify exactly how to arrange conditions to maximize the learning and motivation of every student. This ignores the inherent unpredictability of human behavior. It assumes that behavior can be understood with the same causal models we use for predicting the flight of a golf ball or the reaction of two chemicals. Yet, even physical systems such as the weather can only be described in terms of probabilities. Improvements in our ability to measure winds and moisture and to create ever more sophisticated computer models of the weather will reduce this uncertainty, but they will never eliminate it. Educators are in a similar position when they attempt to apply principles of learning to individual students. Some efforts will fail, but if the research that guides these efforts is solid, educators will, on average, make better decisions than if they had not made the adaptations in instruction.

Myth 5: Individualization Requires Separate Learning Tasks. Some early attempts to individualize instruction implied that each student should work on a different task, one uniquely matched to her or his needs. Most of these efforts were based on behavioral theories of learning that viewed development as a ladder with many small steps, each of which needed to be reinforced. In the extreme, students ended up working alone (in cubicles) on workbooks or computers. Teachers were reduced to paper shufflers and monitors, occasionally dispensing instruction but rarely engaging the group as a whole.

We now know better. We know that students learn by observing and interacting with other students and adults. Groups are especially important for learning how to think. We learn to think in new ways by observing others as they solve problems and then verbally or physically reenacting the process ourselves. With practice, what is at first social and external becomes personal and internal.

Development occurs along many dimensions, not just one. Lower-level skills need not always be learned before higher-level skills. Therefore, instead of searching for the one task that uniquely matches the student’s needs, educators must more often search for tasks that can simultaneously appeal to students at many different levels. In other words, the goal should be to find broad activities that engage many students at once, rather than to find many narrow tasks that uniquely fit the needs of each student.

What do broad tasks look like? Consider, for example, classic stories. Students of different ages can enjoy the same story because it allows entry at multiple levels. The youngest child may attend only to the pictures and to some of the action. An older child may understand the plot, and the adult who is reading the story may appreciate the broader theme. Different students can meaningfully engage a story at different levels or from different perspectives to learn from it. Thus, adaptation does not mean that students should work alone or even that they should be separated into groups.

Important Characteristics of Learners and Learning Contexts

Successful adaptation of instruction requires an understanding of how different kinds of classroom environments can have different effects on students with different characteristics. These effects depend on the characteristics of the students (such as their abilities) and the characteristics of classroom environments (such as the amount of structure provided). A useful way to think about the interdependence is to consider personal characteristics as *propensities*, or tendencies to act or think in certain ways. For example, some students enjoy competition; they have a propensity to notice, or even to seek out, opportunities to engage in competition. A student who does not enjoy competition may not even be aware of these cues. Environmental cues that link to personal characteristics are sometimes called *affordances.* The idea is that situations differ in the activities they afford people who have different propensities. Classrooms in which desks are arranged in circles afford, that is, make likely, social interactions between students. Classrooms in which desks are arranged in rows afford attending to someone at the front of the room.

Instructional environments differ in their demands (what they require of all) and in their affordances (what they make likely or useful). Students differ in their abilities to meet the demands and their sensitivity to its affordances. Whether a quiz is perceived as a challenge or as a threat depends in large measure on the propensities or characteristics of the student. In general, however, some students will be more in tune with the demands and affordances of a situation, whereas others will not. For some there will be harmony, for others discord. The key to making effective instructional adaptations is knowing the major dimensions along which these transactions occur. This is where research is most helpful. Of the hundreds of ways in which classrooms differ from one another, a handful of ways have repeatedly emerged as important sources of harmony or discord. Similarly, of the hundreds of ways in which students differ, some are much more important than others. The section that follows begins first by summarizing characteristics of students and then turns to characteristics of environments.

Important Characteristics of Learners

Successful learning in any domain depends on many personal and social factors, but of the many things that could matter, two matter the most: the students' knowledge and skills in a domain, and their abilities to reason in the symbol systems used to communicate new knowledge in that domain. Classroom assessments report on students' knowledge and skills; they provide information about <u>what</u> students need to learn. But successful adaptation requires knowing <u>how</u> students prefer to learn. *CogAT* measures reasoning abilities in the three major symbol systems required for academic learning, which is why it is so helpful in guiding efforts to adapt instruction. For example, it is not primarily the ability to generate visual images that matters for academic learning, but the ability to reason with and about those images. Similarly, it is not the ability to remember words or to speak fluently that matters more in some instructional treatments than in others, but rather the ability to reason about the concepts that the words signify.

Although information about reasoning abilities and prior achievement are critical for making instructional adaptations, it is not sufficient. Of the many other differences among individuals that can be measured, several have repeatedly been found to moderate the effectiveness of instructional methods. The first characteristic is *affect*, or the feelings that the task elicits or that the student brings to it. Positive affect as reflected in interest in a topic enhances learning; negative affect as reflected in anxiety generally reduces learning. Indeed, anxiety probably moderates the effectiveness of instruction more than any other noncognitive variable.

The second characteristic is *persistence*. Students who lack persistence often have not developed effective strategies for handling intrusive thoughts and emotions, and so they often respond impulsively. They need support, monitoring, and encouragement if they are to be successful. Similarly, students who are mindful, or reflective, learners will generally fare better in a curriculum that encourages discovery than will students who are more impulsive. Although impulsive individuals often prefer activities in which students compete to be first, in the long run they do not fare well in such environments.

These learner characteristics are aspects of knowing, feeling, and willing. *Knowing* involves knowledge and skill in a domain plus the ability to reason in the symbol system(s) used to communicate new knowledge in that domain. *Feeling* involves interest in the task, which enhances learning especially for students who do not have a positive orientation to their own future. Many such students have anxiety about their performance. This anxiety can impair learning, especially in the case of able students in an unstructured or stressful situation. *Willing* involves both persistence, which enhances learning especially when working alone or in unstructured situations, and impulsiveness, which impairs learning especially when working in competitive environments.

Important Characteristics of Learning Contexts

The students' habitual patterns of knowing, feeling, and choosing help determine the types of school environments they perceive. For example, students who are highly anxious will tend to perceive class presentations, tests, and other situations in which they must demonstrate competence quite differently than students who are generally not anxious. In other words, there is no objective way to classify environments. Like beauty, the affordances of a situation are in large measure in the eye of the beholder. Nonetheless, there are a handful of characteristics of classrooms that often moderate the importance of particular characteristics for learning. Note that there are many characteristics of classrooms that are important for learning but that are not mentioned in this discussion. The focus here is on those features of instructional methods that affect students differently depending on their abilities and personalities. Of the many characteristics of teaching methods that have been shown to matter, only four are described. Each is linked to particular learner characteristics.

Structure. Instructional programs differ in the amount of structure they provide. In general, students who have poorly developed reasoning abilities in a domain do better when the instructional program offers greater structure. More-able students, on the other hand, generally do better with less structure. Put another way, more-able students often do better in discovery-oriented environments; less-able students may flounder in such environments. Structure is a variable that also describes the way classrooms are organized. In general, more anxious and more impulsive students fare less well in unstructured classrooms than in more orderly and predictable classrooms.

Novelty/Complexity/Abstractness. Students with poorly developed reasoning abilities typically do less well when the curriculum consists of tasks that are unfamiliar, complex, or require abstract thinking than when the curriculum consists of more familiar tasks that are less complex and fairly concrete. The corollary is that the development of reasoning abilities requires environments that challenge students with novelty, complexity, and the need for abstraction.

Dominant Symbol System. Instructional environments differ in the extent to which they require students to process information in particular ways. The three most important symbol systems demanded in academic learning are verbal, quantitative (or symbolic), and figural (or spatial). One of the most effective ways to adapt instruction is to attend closely to these demands, and, when possible, to allow students to use their better-developed abilities in one symbol system to scaffold learning in another. For example, a student with good verbal reasoning abilities but poor quantitative reasoning abilities can improve the latter by learning to talk aloud about quantitative concepts and relationships.

Opportunities for Working with Others and for Working Alone. Classroom environments differ in the extent to which they allow students to work with others or to work by themselves. Students differ in the extent to which they enjoy working with many others and in the extent to which they can do so successfully. Some students prefer either to work with one or two others or to work alone. In general, knowledgeable students who reason well are more likely to succeed in situations that require working alone. A related difference is the degree to which students enjoy cooperative versus competitive environments. Highly competitive individuals may find it difficult to work productively in a group and, when required to do so, may try to dominate the group. Conversely, students who enjoy collaborating with others may find competitions distasteful, even when all competitors perceive that they have an equal chance to win.

General Principles of Instructional Adaptation

Build on Strength. When students are weak in one area but strong in another, should we try to strengthen the weakness or, instead, to build on the strength? The general rule is to build on strength. Students are better able to process information more elaborately and at higher levels when tasks emphasize the type of thinking they do best. However, there are two cautions. First, instruction must challenge students to go beyond the information given, not merely to register it. This means that instruction geared to their strength must challenge that strength. Second, students must often learn to perform tasks that they do not do well. In such cases, instruction should still aim to build on strength by emphasizing aspects of tasks that avoid their weakness until the students have established a foothold. For example, consider students who have difficulty learning computation skills but who show strength in verbal reasoning. Using group oral recitation would emphasize their verbal strength more than silent practice on a computer. Therefore, the recommendation would be to start with oral recitation and transition to computer practice after oral practice has been successful.

Focus on Working Memory. One of the most pervasive findings in all research on instruction is that more-able students do better when instruction allows them to do things in their own way. Conversely, less-able students do better when given greater instructional support. Instruction that scaffolds (offloads), sequences, and otherwise reduces the burden of information processing, generally helps less-able students. The critical factor here is the burden placed on working memory. When helping less-able students, the key is not so much to reduce the need for thinking as it is to reduce the burden on working memory.

Students generally fail if tasks exceed their attentional capacity. This happens when they try to remember and do more things than they are capable of remembering and doing at one time. In cognitive terms, their working memory is overloaded.

Working memory has three aspects: (1) information storage, (2) information processing, and (3) monitoring/executive functions. Information storage is basically how much "stuff" a person can keep in mind at one time. It is a function of an individual's familiarity with the material, the strategies used to remember it, and the general facility in creating and retaining the type of memory code that best represents the information. People differ in the ease with which they can encode and transform visual images, sequences of sounds, numbers, and other symbols.

When we measure working memory, we do not simply ask people to remember something. Rather, we require that they remember something while transforming it into something else. This requires storing, processing, and managing the tradeoff between the two. Thus, both transformation and self-monitoring processes are also important aspects of working memory. Self-monitoring has several aspects. Most importantly, it means keeping track of what one is doing and what one has already done. This helps the individual avoid doing the same thing twice. It also means comparing performance with a goal or a standard.

Effective use of working memory resources is critical for successful reasoning. Students cannot make inferences about how two or more ideas are connected if they cannot hold the ideas in mind. Nor can students compare goals with outcomes, revise strategies to accommodate feedback, engage in any of a hundred other forms of critical thinking and reasoning if working memory resources are inadequate. Two of the most important questions for educators to ask regarding their students then, are: (1) What are the major demands that this activity places on the students' working memories? and (2) Which of these processes, or memory requirements, can be offloaded, or scaffolded?

Scaffold Wisely. Whenever students try to solve problems, there are many processes that must be executed simultaneously in working memory. *Scaffolding wisely* means offloading, at least for the moment, those memory requirements and processes that are not the object of the instructional activity. For example, the demands of spelling and grammar can easily overwhelm the working memory resources of a beginning writer. Offloading these processes temporarily frees the student to construct a connected narrative. Similarly, one of the last steps in the acquisition of skills is learning to monitor one's own performance. Especially in the early stages of skill acquisition, monitoring functions can be offloaded to another individual by having students work in pairs. Writing things down, drawing pictures, and practicing a skill until it can be performed automatically also reduces demands on working memory.

Historically, one of the most common accommodations for students who had difficulty making inferences, deductions, and elaborations was to offload the reasoning requirements of tasks. This works well in the short run but leaves students increasingly unprepared to face the challenges of school learning. Therefore, when reasoning is an essential part of the task, endeavor to offload reasoning last.

Emphasize Strategies. Psychologists who study reasoning distinguish between tacit and intentional reasoning processes. Tacit processes occur outside of awareness. They typically do not require much attention and are performed quickly and intuitively. Intentional processes, on the other hand, require conscious awareness. Intentional thinking is often described as effortful and rule-based. Such reasoning processes are made more broadly useful when students learn to use them strategically. At the lowest level, this means simply having a strategy that one can consciously use when necessary. At intermediate levels, it means having multiple strategies available for possible use. At a more advanced level, it means knowing under what circumstances each strategy is best used. At the highest level, it means becoming strategic and reflective in one's thinking. Instructional adaptations are most effective over the long haul if they help learners become more intentional and self-regulated in their learning. Encouraging students to use and monitor the effectiveness of different strategies helps them better use their cognitive and affective strengths and avoid, or scaffold, their weaknesses.

When Grouping, Aim for Diversity. It is generally not wise to group students by score levels or by score profiles. Students are most likely to improve their ability in a domain if they have the benefit of learning from classmates whose skills and approaches to problems differ from theirs. This is particularly important for students who have a marked deficit in one area. Improvement is more likely if such students have high-quality interactions with individuals who have a relative strength in the same area than if they are constantly paired with other students who, like themselves, have difficulty in that domain. More-able students benefit from such groups to the extent that they are asked to provide explanations and assistance. Highly gifted students, however, can benefit from groups that are more homogeneous in ability but diverse in the range of perspectives offered by participants.

PART 3

Instructional Suggestions for Students of Different Ability Levels

There is both unity and diversity in cognitive abilities. Unity is reflected in the substantial correlation between measures of verbal, quantitative, and figural reasoning abilities. Students who obtain a high score in one domain are likely to be above average in the other two domains. Cognitively, it means that reasoning tasks share common attention, memory, and other processing resources. On *CogAT,* unity is estimated by the overall height, or level, of the score profile. This is captured by the median age stanine.

Diversity of abilities is reflected in the fact that although tests of verbal, quantitative, and figural reasoning are correlated, these correlations are much lower than the reliabilities of the three reasoning tests. Cognitively, it means that students differ in their abilities to reason with verbal, quantitative, and figural symbols. On *CogAT,* diversity is reflected in the pattern of the scores on the Verbal, Quantitative, and Nonverbal batteries.

The implications for instruction of any score profile must take into account both the overall level of the three scores and the pattern of the three scores. In Part 3 of this guide we consider differences in the overall *level* of the profile. These differences are divided into four groups based on the median, or middle, age stanine:

Stanines 1–3	Below Average
Stanines 4–6	Average
Stanines 7–8	Above Average
Stanine 9	Very High

Parts 4 and 5 of this guide consider some of the major differences in the pattern of scores. Part 4 discusses how to capitalize on relative strengths in reasoning abilities. Part 5 considers the opposite problem of scaffolding or shoring up specific weaknesses.

Instructional Suggestions for Students with Poorly Developed Reasoning Abilities (Stanines 1–3)

Students with poorly developed reasoning abilities often have difficulty learning abstract concepts. Few have effective strategies for learning and remembering. Therefore, they tend to approach learning tasks in a trial-and-error fashion. They typically do not spend much time planning before attempting to solve a problem. As a result, they frequently do not transfer knowledge and skills learned in one context to another context unless prompted to do so. Such students have difficulty detecting relationships, similarities, and differences that go beyond appearances and are easily distracted by salient but irrelevant details in problems.

- **Build on Strength.** Students who have low median or composite scores are much more likely than other students to have a significant or extreme strength on the one of the *CogAT* batteries. Build on this strength (see Part 4 of this guide); also look for strengths in terms of specific interests and achievements. Even more than other students, those who are behind their peers in reasoning abilities will often learn more and sustain their efforts longer if the teacher discovers and builds on their cognitive strengths and personal interests. This is not always possible, but to the extent to which it can be done, it will lead to greater effort and a generally more sophisticated outcome.

  These students often have other competencies that can be emphasized, especially when working in groups. Using these skills helps legitimize the students' participation in the group. Students who feel that they are participants (rather than observers) have higher levels of motivation and engagement in a task. For example, such students may be able to help draw a poster that summarizes the group's discussion, or to take the lead role in a demonstration.

- **Focus on Working Memory.** Attending carefully to the demands placed on working memory can reap great benefits for students with poor reasoning skills. These students are commonly required to do more things at one time than they can do. Learning may start out meaningful, but soon it degenerates into an anxious search for surface features of tasks that suggest a solution. Since the primary burden on working memory comes from the concepts, images, sound sequences, and sentences that must be held in mind, the most effective way to improve performance is to reduce the number of things that must be held simultaneously in working memory. For example, some students will have difficulty coordinating what they hear with what they see or what is on the board with what is on the paper in front of them. Eliminating the need to remember ideas—even temporarily—can greatly assist these students.

  Working-memory burdens can also be reduced by using familiar concepts, by making concrete analogies to familiar physical systems, by automatizing skills (such as writing, typing, or calculating), and by offloading items to be remembered or processes that must be performed simultaneously.

- **Scaffold Wisely.** Good reasoners engage in what psychologist Robert Sternberg calls *selective encoding.* This means that they know what to attend to and what to ignore when trying to understand a problem. Students with poorly developed reasoning abilities often have difficulty identifying what is important to learn and in judging where they should focus their attention in a learning situation. Therefore, they need very specific directions before they start a task or start to study. The use of attention-getting directions can help such students focus on the important aspects of a task, particularly in reading.

Typically, students with these profiles learn more effectively in structured learning environments that make fewer demands on their cognitive resources and provide more direct guidance, coaching, and support. Such students also tend to process information slowly and to need a slower pace of instruction than students with average scores on *CogAT* (stanines 4–6). Instructional strategies that use teacher or peer modeling, concrete representations of abstract concepts, demonstrations, pictures or other types of illustrations, films, and hands-on activities are likely to be more effective than verbal explanations. "Doing" is preferred to talking about doing.

A critical issue for instructional programming for these students is the tradeoff between short-term gains and the development of long-term competence. Highly structured environments that remove the information-processing burden from the learner almost invariably result in higher immediate achievement for such students. When offloading processing burdens, however, there is a tendency to dispense with higher-order reasoning processes and retain lower-order memory and skill execution processes. Therefore, to the extent possible, instruction should scaffold lower-order processes and memory burdens and should encourage the development of reasoning and meaning-making abilities for these students.

- **Encourage Strategic Thinking.** A few good rules that help students to be more reflective in their learning are more helpful than a detailed list of particular strategies. Planning and practicing when to apply a rule is as important as learning to apply the rule in one context. Since these students have considerable difficulty identifying appropriate situations in which a particular strategy should be used, the teaching of learning strategies is likely to be much more effective if it is done by modeling and demonstration in the context of ongoing learning situations in the classroom. More-able peers can sometimes provide the guidance these students need in order to focus on relevant aspects of a task, to keep track of what they are doing, and to avoid practicing errors.

  Students who struggle to keep up often automatize procedures that get them through a task but that are not generally useful. It is critical, therefore, that students who have difficulty monitoring themselves and who are prone to making errors be carefully monitored during the early phases of skill acquisition to ensure that they have understood the procedure or strategy and are applying it correctly.

- **When Grouping, Aim for Diversity.** Students who have difficulty reasoning when alone typically learn more effectively and have higher levels of achievement when they have many opportunities to interact with more-able peers. To the extent possible, then, students with median stanine scores of 1 to 3 should not be segregated in classes or groups consisting solely of low-scoring students. Participation in activities of all sorts, however, can occur at many levels. Students who have not yet learned how to participate fully in an activity can learn much by observing, listening, and doing what they can.

Instructional Suggestions for Students with Average Levels of Reasoning Abilities (Stanines 4–6)

- **Build on Strength.** Although these students have good resources for learning, they often have difficulty applying what they know when learning a new task, particularly when the task looks different from one they had previously learned. Help them develop the habit of analyzing new tasks to detect relationships with tasks previously learned. Do this by modeling the process for them. These students' strengths will primarily be evident in their interests and, to a lesser extent, in their levels of achievement in different domains. Strive to find ways to encourage the particular academic accomplishments of students. Finding and nourishing the islands of excellence in all students' schoolwork spreads encouragement.

- **Focus on Working Memory.** Students with average reasoning abilities are frequently working at the limits of their attentional resources. Changes in instructional methods or learning strategies that reduce the burden on working memory can have a significant impact on their success in learning. Often working-memory burdens can be reduced by fairly simple modifications of instructional methods, such as putting all the needed information on a single sheet of paper; using familiar, concrete concepts rather than unfamiliar, abstract symbols; and overlearning skills that assist in problem solving and comprehension. Self-monitoring skills are especially troublesome for such students, particularly in the primary grades. Offloading monitoring to another individual by having students work in pairs can be especially effective early in the process of acquiring a new skill or strategy. Also, keep in mind that working-memory burdens will change dramatically as these students gain proficiency with a skill. What is initially overwhelming can, with practice, be well within the student's range.

- **Encourage Strategic Thinking.** Memory burdens can also be reduced and thinking made more systematic and successful if students learn to be more strategic and less algorithmic in their thinking. Since they often make errors in implementing learning strategies, these students need frequent monitoring when they are learning a new strategy, so that their errors can be corrected. Modeling correct implementation of a strategy is likely to be more effective than simply providing a verbal explanation of it. Students with these score levels benefit from direct instruction in study skills, such as note taking, outlining, diagramming, planning use of time, and formulating questions to guide their study. They also need help to learn how to break up complex problems into simpler units and how to keep track of their progress in solving complex problems. The goal is to help students become mindful of their own strengths and weaknesses and of the effectiveness of different strategies in different contexts.

- **Scaffold Wisely.** Students with average scores tend to learn more effectively in school environments that are somewhat, but not highly, structured. These students tend to learn best when instruction is moderately paced and when there is frequent monitoring and feedback on their progress. The goal of good instruction is to provide students with enough support in the form of strategies, memory prompts, and task structure that they can infer, deduce, connect, and elaborate—in short, understand and think for themselves.

- **When Grouping, Aim for Diversity.** Students typically learn how to think in new ways by first enacting skills externally. Only after much overt practice can a skill be executed mentally. Many cognitive skills seem to be acquired first by observing other students modeling an interaction and then by gradually learning to participate in the same sort of exchanges. Encourage this by structuring groups so that higher-order skills are modeled and then practiced in student conversations. Since research shows that students with average abilities are often left out of group problem-solving efforts, try to structure group interactions so that all students have an equal opportunity to participate.

Instructional Suggestions for Students with Above-Average Levels of Reasoning Abilities (Stanines 7–8)

- **Build on Strength.** These students generally profit most when allowed to discover relationships themselves. Guided discovery methods work better than more structured teaching methods. These students need to be challenged with materials, projects, and problems that are somewhat more difficult than those used for the typical student. Improve their reasoning skills by encouraging them to find modes of communication that most precisely describe the relationships among concepts or the rules that sequence them. For example, in writing, encourage students to find words that express ideas exactly rather than approximately. Encourage these students to follow their interests, and reward perseverance on long-term projects.

- **Focus on Working Memory.** Although these students need less practice than average students to master new skills, they acquire complex skills more readily if self-monitoring processes are temporarily offloaded to another student or to a teacher. Enhance working-memory resources dramatically by automatizing low-level skills. This is often best accomplished through focused practice on particular skills. Teach students how to monitor their own thinking and problem solving by recording their thoughts on paper. Show them how carefully studying the written record allows them to revise and clarify their thinking in a way that is impossible when thinking is limited to that portion of an idea sequence illuminated in working memory.

- **Encourage Strategic Thinking.** Able students are quick to acquire different learning strategies. Exposure to alternative strategies—especially if modeled by high-status adolescents or adults—can help students appreciate the value of different strategies for different persons and problems. Encourage students to try each and help them keep track of the results. As students progress beyond middle school, encourage them to expect changes in strategies that work best for learning.

- **When Grouping, Aim for Diversity.** Above-average students are generally excellent group participants, especially if the group is structured so that no one can dominate the discussion or be left out of it. These students can learn well in groups by explaining, by helping to summarize discussions, and by modeling higher-order thinking skills for other students.

Instructional Suggestions for Very Able Students (Stanine 9)

- **Build on Strength.** Students who reason exceptionally well benefit most from discovery learning and least from highly structured learning environments. Good discovery learning need not be a solitary task. All students learn most when in the company of other learners who model new ways of understanding a problem and who challenge the learner to improve his or her current understanding.

  The single greatest need of very able students is for academic challenge at a level commensurate with their abilities and achievements. Sometimes this can be accomplished by the careful selection of challenging instructional materials, special projects, or other enrichment activities; but it often requires instruction, particularly in science mathematics, at a level several years in advance of that received by similarly aged peers.

- **Emphasize Strategies.** Very able students are generally receptive to activities that allow them to discover how they can best use their cognitive resources. For students in the early primary grades, this can mean learning not only that there are different ways to attain competence in performing a skill, memorizing poetry, or solving problems, but also that learners have the option of discovering which methods work best for them. For older students, place emphasis on developing thinking dispositions such as reflectiveness and the willingness to shift perspectives and consider alternative opinions and evidence, to decontextualize problems, and to entertain increasingly sophisticated theories of what counts as knowledge and evidence.

- **Scaffold Wisely.** Very able students need access to instruction that allows and encourages them to develop their academic skills. Some also need help in coping with anxiety and other disruptive emotions. However, because many bright students are not sufficiently challenged, they do not develop strategies for persisting in the face of difficulty. Working with an older and more experienced student (or adult) can be especially beneficial.

- **When Grouping, Aim for Diversity.** Very able students can benefit from group interactions when they are able to explain difficult concepts to other students, but they learn more when they are able to participate as learners as well. Thus, when grouping very able students with other students, try to devise groups in which they will be learners—not just explainers—and in which there will be a diversity of perspectives among participants.

PART 4

Adapting Instruction to Build on Relative Strengths

Approximately half of the students who take *CogAT* show a relative strength or a relative weakness in one of the three test batteries. Understanding this provides the opportunity to adapt instruction to build on the student's strengths and shore up any weakness.

Ability profiles with a **V+, Q+,** or **N+** indicate a **relative strength** on the Verbal, Quantitative, or Nonverbal Battery, respectively.

Profiles that show a relative strength are more common for low scores (median age stanines of 1, 2, or 3) than for high scores (median age stanines of 7, 8, or 9).

Profiles that show an extreme strength (**E**) are most common for students with a median stanine of 1. In fact, profiles for students with a median age stanine of 1 that show a significant or extreme strength are almost as common as profiles that show a relatively flat (**A**) profile. Both occur for about 45 percent of students nationally.

The information that follows offers suggestions on adapting instruction to build on a relative strength indicated by a student's *CogAT* ability profile.

Relative Strength	**Cognitive Domain**	**Page**
V+	Verbal	23
Q+	Quantitative	25
N+	Nonverbal	26

Ability profiles with a **V–, Q–,** or **N–** indicate a **relative weakness** on one of the three *CogAT* batteries. Guidance on shoring up weaknesses begins on page 28.

Relative Strength in Verbal Reasoning (V+)

Learner Characteristics	These students typically obtain higher-than-expected achievement test scores in all areas except mathematical computation. The differences between observed and expected achievement are smallest at the primary level and largest at the secondary level. A strength in verbal reasoning has this broad effect on achievement because verbal reasoning abilities are important for success in virtually all school subjects.
Relative Strength	Indicators of a relative strength in verbal reasoning include the following: • The students generally do best when they are encouraged to talk and write about what they are attempting to learn. • Many (but not all!) of these students often have remarkably good memories for arbitrary sequences of sounds, letters, words, and events. Thus, they typically are above average in spelling; in their knowledge of syntax and grammar; in their ability to learn other languages; and in their ability to remember dialogue, prose, and poetry.
Building on Strength	Instructional opportunities to build on students' strength in verbal reasoning include the following: • Offer greater challenges in areas of the curriculum that involve reading, writing, and speaking. At the elementary level, this may mean providing special reading or writing assignments that are more demanding than the assignments given to other students. At the secondary level, if scores on the Verbal Battery are particularly high (stanine 8 or 9), it may mean placement in honors or advanced-placement classes. • Encourage these students to use their superior verbal reasoning skills to achieve at higher levels in other curricular areas, particularly in mathematics. For example, these students will often learn best if encouraged to restate mathematical expressions verbally and to explain them to others. • Avoid this pitfall in mathematics: Students with relatively strong verbal abilities often find it easier to memorize formulas than to build more abstract, often spatial mental models of the same conceptual systems. It is the latter that leads to long-term retention of mathematical concepts and, more importantly, to the ability to transfer mathematical knowledge to unfamiliar domains. Take steps to discourage these students from simply memorizing formulas. The use of computers with graphing capabilities can help in this respect. Most importantly, use learning materials and test problems that allow these students to use their strong verbal reasoning skills instead of their rote memories when learning mathematics. • Especially at the primary and early elementary levels, encourage these students to practice mathematical facts orally rather than silently. Consider how one best learns common replies to questions posed in a foreign language and try using similar methods here. Expect that these students will need more practice for mastering mathematical skills than they need for mastering reading and language skills. • Encourage the habit of creating a mental model and coordinating it with a verbal description. These students sometimes have difficulty creating a visual mental model of the scenes depicted in a story. Read aloud to such students, pausing frequently to respond to their questions or to ask what they envision. For young students, select texts with illustrations and ask students to make explicit connections between the text and the illustration.

Relative Strength in Verbal Reasoning (V+), *continued*

Building on Strength	• For young students or for those who still have difficulties understanding stories, allow them to make a model of the situation described in the story and then to alter the model as changes occur in the text. The goal should be to learn how to create visual mental models that allow them to keep track of the persons and events described in the text. If students are able to read and write about events that occur in locations that they know well, illustrations may not be needed.

Relative Strength in Quantitative Reasoning (Q+)

Learner Characteristics	Students in the primary grades who show a strength in quantitative reasoning tend to score somewhat higher than expected (on the basis of their verbal and nonverbal reasoning abilities) on both the mathematics and language portions of standardized achievement tests. By the elementary years, however, the advantage is confined to mathematics and persists through the high school years.
Relative Strength	Indicators of a relative strength in quantitative reasoning include the following: • Students are capable of abstract thinking. At lower ability levels, a quantitative strength may be apparent in the student's abilities with the computational aspects of mathematics rather than the conceptual aspects. • Students who display high levels of quantitative reasoning abilities typically excel in identifying patterns from their experiences and then reasoning with these abstractions. • They often learn computer skills more readily than their peers, especially skills such as procedures for using text editors and spreadsheets. They do not typically excel at computer programming unless their quantitative reasoning abilities are quite high. • Students who excel at learning rule-based mathematical knowledge often show better-than-expected knowledge of grammar.
Building on Strength	Instructional opportunities to build on a strength in quantitative reasoning include the following: • Exploit and further develop this ability. If quantitative reasoning scores are very high, this may mean acceleration for some students; others benefit from enrichment activities such as math clubs or honors classes. Selecting appropriate strategies requires knowledge of a student's level of achievement in mathematics and of personal factors such as anxiety about working with older students. • Provide opportunities for these students to contribute at high levels to group projects. A strength—especially an extreme strength—in quantitative reasoning can be a source of great pride. Group projects provide an avenue for building better verbal and spatial reasoning abilities. • If students have strong grammar skills, praise this strength and ask the students to give feedback on each other's writing. This activity, in turn, can help these students acquire knowledge of higher-level writing skills (such as principles of style or organization). • Encourage development of their abilities through mathematical tasks, games, and puzzles that can be engaged in cooperatively rather than competitively.

Relative Strength in Nonverbal Reasoning (N+)

Learner Characteristics	Students who show a relative strength on the Nonverbal Battery can be either very good at reasoning with spatial stimuli or particularly adept at solving novel problems that are unlike those encountered in school. Choosing between these explanations often requires information outside the test results (for example, knowledge of a student's learning style and extracurricular activities of choice and, for older students, their career interests). Students with particularly strong spatial abilities often experience difficulties in verbal fluency (as when writing under time pressure or speaking extemporaneously) or in remembering sequences of words or letters (as in spelling). On the other hand, these students often excel at drawing, sculpting, and other visual and mechanical arts. Another possibility is that this profile represents not so much a strength in spatial reasoning as a weakness in both verbal and quantitative reasoning abilities. These students need activities both in and out of school that will develop their verbal and quantitative reasoning abilities. For suggestions on improving these areas, see "Adapting Instruction to Shore Up Weaknesses," beginning on page 28. Paradoxically, students who have a relative strength on the Nonverbal Battery tend to obtain ***lower*** scores on some portions of standardized achievement tests than those of students with the same levels of verbal and quantitative abilities but an **N–** profile. Most achievement tests do not measure spatial reasoning. A strength in and preference for spatial reasoning runs counter to the predominantly linear and verbal modes of thinking required by conventional schooling. Although much effort is directed toward the development of students' verbal and, to a lesser extent, quantitative reasoning abilities, very little effort is made to develop their spatial reasoning abilities. Yet these abilities routinely play an important role in high-level learning and in creative contributions in mathematics, science, engineering, and the visual arts. Like verbal and quantitative reasoning abilities, spatial reasoning abilities respond to instruction. Students with a nonverbal strength often perform less well on tasks that require verbal fluency, such as speaking and writing. Indeed, extremely high levels of spatial ability are associated with a diverse array of specific verbal problems such as stuttering, difficulty learning phonics, poor spelling, and difficulty speaking foreign languages.
Relative Strength	The suggestions in this section are based on the interpretation that the **N+** profile represents a strength in spatial thinking. Indicators of a relative strength in nonverbal reasoning include the following: • Students tend to prefer visual mental models when solving problems. They respond well to texts that contain difficult graphics and prefer maps to verbal directions. • Learning is easiest for these students when they can readily connect each new concept or relationship with a mental or physical model (e.g., a schematic drawing) of the situation. At younger ages, these students learn most readily when the concepts described in textbooks and other media have previously been experienced concretely and can subsequently be applied concretely.

Relative Strength in Nonverbal Reasoning (N+), *continued*

Building on Strength	Instructional opportunities to build on students' strength in nonverbal reasoning include the following: • For young students, provide reading texts that contain detailed illustrations, especially for unfamiliar content for which the students cannot form their own mental model. • In all areas of the curriculum, but especially in science and mathematics, use metaphors, analogies, and real-world examples to help students connect unfamiliar, abstract concepts to more familiar objects or experiences. Such relationships not only enable students to understand but also greatly facilitate retention and transfer. • Instead of presenting information verbally at a rapid or inflexible rate, allow students to control the rate at which the information is presented (such as pausing and replaying a recording). • Encourage students to create drawings when solving problems in mathematics, concept maps when taking notes, or mental models of a scene when reading a text. For young students especially, ask, "What do you see?" and allow them to describe a mental picture. Ask older students to illustrate the scene. • Provide a hands-on approach to learning. Relate student interests to traditional, academic subjects and offer physical applications for problem solving. • When teaching writing, encourage these students to try descriptive rather than narrative prose. Provide examples of good descriptive prose. Have them first envision the scene they would like to describe before they attempt to describe it to someone else. • Encourage the development and application of these students' spatial reasoning and thinking abilities. These students are often quite skilled in the visual arts and can excel in trades such as carpentry, landscaping, interior decorating, product design, and computer graphics.

PART 5

Adapting Instruction to Shore Up Weaknesses

Ability profiles with a V–, Q–, or N– indicate a **relative weakness** on the respective *CogAT* battery. When a student displays a significantly lower score on one of the three batteries, it typically indicates a preference for thinking in another cognitive domain or symbol system.

Profiles that show an extreme (**E**) weakness are most common for students with a median age stanine of 9. Indeed, for students with a median age stanine of 9, profiles that show a significant or extreme weakness are almost as common as relatively flat (**A**) profiles. This is one reason why the *CogAT* author discourages use of the overall *CogAT* composite score to identify academically talented students.

The information that follows offers suggestions on adapting instruction to shore up a weakness indicated by a student's *CogAT* ability profile.

Relative Weakness	**Cognitive Domain**	**Page**
V–	Verbal	29
Q–	Quantitative	31
N–	Nonverbal	33

Relative Weakness in Verbal Reasoning (V–)

Learner Characteristics	These students prefer nonverbal (visual) or quantitative reasoning and often find it difficult to translate their thoughts into words. Over time, this propensity causes a lag in their development of verbal abilities of all sorts. Verbal skills are so critically important for school learning, however, that these students must be encouraged to develop and use their speaking, reading, and listening abilities. Students with this profile often have lower scores on achievement tests than would be expected on the basis of their median age stanine score on *CogAT*. Students who exhibit relatively poor verbal skills often do so because they do not routinely participate in conversations that require the formal language structures or types of dialogues required in academic learning.
Relative Weakness	Indicators of a relative weakness in verbal reasoning include the following: • Activities that are unnecessarily verbal thwart the students' performance even in areas in which they excel. Common sources of difficulty are directions that are overly long and tests that require the translation of verbal prompts or that require verbal responses. • Students with lower verbal scores (stanines 1–4) often find themselves overwhelmed in the classroom, especially when following directions for the first time or when attempting to transfer their attention between different verbal activities. For example, this situation can occur when students are required to view a rapidly paced video presentation and take notes at the same time.
Shoring Up the Weakness	The critical importance of verbal reasoning abilities for success in school requires that relatively more effort be expended improving these abilities than would be expended to improve a relative weakness in quantitative or, especially, nonverbal reasoning. Suggestions for adapting instruction for these students include the following: • To improve performance and reduce frustration, reduce the demands placed on verbal working memory. For example: – Do not expect these students to keep in mind a verbal statement and apply it at the same time. Allow the student to use a prompt, such as a written statement of the concept or strategy needed for the work at hand. – Offload monitoring to another student by having students work in pairs. – Allow many opportunities to practice a new strategy in diverse contexts. – Help students who scored at lower stanine levels to identify the conditions that cue possible use of a new reasoning strategy. Then try to arrange for such conditions to occur unpredictably. The goal is for students to learn to call up and use different procedures as circumstances demand and not rely on fixed strategies in all cases. • To improve students' verbal reasoning abilities, provide exposure to individuals who model hoped-for styles of verbal discourse and verbal reasoning as well as opportunities to engage in conversations in which they practice these speech patterns.

Relative Weakness in Verbal Reasoning (V–), *continued*

Shoring Up the Weakness	• Offer a broad language curriculum that combines reading, writing, and speaking as well as opportunities to practice and receive feedback on each. Keep in mind that at all levels, language-related reasoning begins with the oral and external; only after much practice does a reasoning strategy become internalized and automatic. Thus, emphasize acquisition and use of oral language skills in the dialect encountered in reading and expected in writing. • Acquaint students with unfamiliar ways of conversing and writing by providing opportunities to imitate the speaking and writing styles of individuals they admire. Drama, poetry, and storytelling are particularly useful in this regard. After students practice the language forms and syntactic structures orally, they can more readily apply them in written essays and stories.

Relative Weakness in Quantitative Reasoning (Q–)

Learner Characteristics	When compared with students who have an even (**A**) profile across all three batteries, students who display a relative weakness in quantitative reasoning tend to score somewhat lower across all portions of standardized achievement tests, especially at the primary level. The difference is largest on the mathematics, computation, and language usage tests. A relative weakness in quantitative reasoning abilities generally has a broader impact on the achievement of students than does a relative strength in quantitative reasoning. The connection between lower achievement on the computation and language tests could reflect a common difficulty in learning rule-based systems, or it could reflect a lack of instruction in both areas. Only someone familiar with the students and the educational curricula they have experienced can make this judgment. There are many causes of a relative weakness in quantitative reasoning. Some students have difficulty creating, retaining, and manipulating symbolic representations of all sorts. For some students, this problem seems confined to numerals; for others, however, it stems from a more fundamental difficulty in thinking with abstract, as opposed to concrete, concepts. For example, even the most elementary concepts in mathematics are abstractions. When counting objects, students must recognize that the number 3 in “3 oranges” means the same thing as the number 3 in “3 automobiles.”
Relative Weakness	Indicators of a relative weakness in quantitative reasoning include the following: • Some students prefer more concrete modes of thinking and often disguise their failure to think abstractly when using verbal concepts. For example, a student may use the word *dog* appropriately but may think only about her or his dog when using the word. • For other students, the difficulty lies in the failure to develop an internal mental model that functions as a number line. For these students, solving even basic computations such as adding 2 to a given number is a challenge. When performing computations, such students often make substantial errors that they do not detect unless prompted—and even then they may not notice the errors. • And for other students, the weakness represents nothing more than a lack of experience in thinking and talking about quantitative concepts. This is fairly common in the primary grades. It surfaces again at the secondary level among those who avoid mathematics. At the middle school and high school levels, math anxiety can also be a significant issue.
Shoring Up the Weakness	Remediating a weakness in quantitative reasoning requires an understanding of the source of the deficit. Select strategies from the following list that seem most appropriate for the student and the learning situation: • If students have difficulty reasoning abstractly, help them focus on the quantitative aspects of a stimulus while ignoring more compelling perceptual features (as in the previous example of 3 oranges/3 automobiles). • If students have not established or cannot readily use a mental model for representing numeric quantities, give them practice in drawing a number line and then trying to envision and use a mental number line to solve basic addition and subtraction problems. It will take a substantial amount of practice before they can automatically conceive and use a mental number line to solve problems.

Relative Weakness in Quantitative Reasoning (Q–), *continued*

Shoring Up the Weakness	• If the difficulty is a lack of experience or the presence of anxiety, provide greater structure, reduce or eliminate competition, reduce time pressures, and allow students greater choice in the problems they solve. Experiencing success will gradually reduce anxiety; experiencing failure will cause it to spike to new highs. • Help these students discover how to use their better-developed verbal and spatial reasoning abilities for solving mathematical problems. At all grades, but especially in middle school and high school, encourage these students to develop the habit of restating mathematical expressions in words. Encourage them to talk about mathematical concepts rather than silently solving problems on work sheets or computer screens. When learning computation skills, they can recite mathematical facts orally and in groups. • Provide opportunities for these students to exploit their stronger spatial reasoning abilities by encouraging them to create drawings that represent essential aspects of a problem. Show them how drawings can range from concrete depictions of the objects described in the problem to increasingly abstract representations that capture only the essential aspects of the problem. • Encourage students to use computers and other tools to offload lower-level computation processes and to focus instead on higher-level concepts. This is often best done using graphic representations of geometric and algebraic concepts.

Relative Weakness in Nonverbal Reasoning (N–)

<table>
<tr><td>Learner Characteristics</td><td>The implications of a relative weakness in nonverbal reasoning are best understood by comparing achievement test scores for such students with the scores of students who have similar levels of verbal and quantitative reasoning abilities but no deficit in nonverbal reasoning. At the primary and elementary levels, students with a relative weakness in nonverbal reasoning tend to have lower scores on standardized achievement tests in the areas of reading and mathematics. At the secondary level, the deficit is largest in the area of science.

At all levels, but especially at the primary and secondary levels, these students also have lower composite scores on achievement tests. A weakness in nonverbal reasoning ability has more noticeable and negative consequences for achievement for average-ability students than for students who score in the high (stanines 7–8) or very high (stanine 9) range on CogAT.</td></tr>
<tr><td>Relative Weakness</td><td>As with a relative strength in nonverbal reasoning, there are two explanations for a relative weakness in nonverbal reasoning: Either the student has difficulty reasoning with figural-spatial stimuli or the student has difficulty solving unfamiliar problems. Before adapting instruction for these students, try to identify the source or cause of their deficit. Consider the following possibilities:
For most students, the N– pattern is caused by difficulty with figural-spatial stimuli. Fortunately for them, high levels of spatial reasoning abilities are not required for success in conventionally structured schools. In fact, a relative strength in nonverbal reasoning is often more of a hindrance for students who obtain above-average scores on CogAT. Moderate levels of spatial reasoning abilities are required for success in school, however. Students with weak spatial reasoning abilities encounter difficulties in many areas of the curriculum, especially science and mathematics.
Sometimes the N– pattern indicates a difficulty solving problems unlike those encountered in school rather than a relative weakness in spatial reasoning. If this is the case, you are likely to notice a systematic decline in performance as the student moves from school-like tasks to unfamiliar tasks. Support for this interpretation may come from observations of the student's study habits and anxiety level. Difficulty in solving novel problems is suggested when the student works diligently, even obsessively, at school tasks. Such students often become anxious when placed in situations that lack clear guidelines on what they are expected to do or how they will be evaluated. Performance declines are also notable in test results. For example, in the verbal domain, the student performs best on the Iowa Assessments™ Language test, somewhat lower on the Iowa Assessments Reading tests, lower still on the CogAT Verbal Battery, and lowest on the CogAT Nonverbal Battery. A similar progression would be apparent in the quantitative domain.</td></tr>
<tr><td>Shoring Up the Weakness</td><td>Remediating a weakness in nonverbal reasoning requires an understanding of the source of the deficit. Select strategies that seem most appropriate for the student and the learning situation.

Spatial reasoning abilities can improve with instruction. Educational planning for students with N– ability profiles should include training in the specific types of spatial thinking required by the curriculum. Start with concrete objects and physical models of concepts used in the curriculum. Then, teach students to draw the model from memory. In teaching</td></tr>
</table>

Relative Weakness in Nonverbal Reasoning (N–), *continued*

<table>
<tr><td>Shoring Up the Weakness</td><td>
geography, for example, have students view a map of western Europe and then draw it from memory, revising the drawing after additional looks at the map. The act of drawing the map from memory will result in greater retention of the images than having students merely view the map without any drawing.
In many learning situations, however, it will be easier for the students if instruction compensates for, or scaffolds, their poor spatial reasoning abilities. When working with these students, watch for signs that they do not understand because they cannot envision the situation or create a model to represent it. Use instructional strategies and methods such as the following:

Replace the question “Do you see…?” with the more informative “What do you see?”
Provide simple drawings that encapsulate the essential features of the visual mental model required by the problem. Then give students time to examine the drawing and to label it or coordinate it with the text.
When possible, do not require the students to shift their attention between two different locations, such as a drawing displayed on the board or LCD projector and a description of the problem in a textbook or workbook. Place the text and drawing in view together or allow students to study the drawing while you read the problem aloud or explain it to them rather than requiring students to read the text themselves.
Avoid problems that require transformation of images such as imagining how the drawing would appear from another perspective or following a dynamic transformation. Use computer graphics or physical models to display such transformations. This can be especially helpful in mathematics.
Allow students to inspect and physically manipulate objects if necessary.
In writing, encourage these students to add descriptions to their stories or essays.
When teaching strategies, summarize them in short verbal statements that can be rehearsed and committed to memory. When practicing strategies, encourage these students to repeat (aloud) the statements as they perform each step.
In mathematics, emphasize strategies that can be summarized verbally. Offload the need for students to visualize by providing drawings, using computer graphics, or having students work in groups in which a partner performs this part of the task.

If, on the other hand, the N– score pattern seems to reflect a difficulty solving problems unlike those encountered in school rather than a relative weakness in spatial reasoning, a different strategy is called for.

Provide gentle encouragement to engage the students in discovery learning. A student’s problem-solving skills need to be stretched to apply to increasingly unfamiliar, usually less-structured situations. Stretch gently; such students can be overwhelmed if the task demands too much insight, creativity, or transfer, or if they perceive criticism rather than encouragement in the feedback they receive.
Encourage and reward small steps away from familiar tasks toward tasks that are less familiar and increasingly less structured. This approach gives students practice in assembling and reassembling strategies to solve new problems. It also helps students develop a willingness to attempt the unfamiliar, which is equally important.

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PART 6

Adapting Instruction for Mixed Ability Profiles

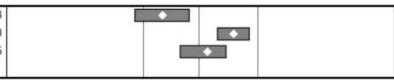
C Profiles Explained

C profiles show a significant contrast between the student's highest and lowest battery scores. The general pattern for **C** profiles is one high score (a relative strength), one middle score, and one low score (a relative weakness). Sometimes all three scores differ significantly from one another.

In a *CogAT* report that graphs a student's battery scores, scores that differ significantly have confidence bands that do not overlap. If the bands around two scores overlap, those scores do not differ significantly from one another.

In the example below, Verbal and Quantitative scores differ significantly. For this student, Quantitative is a relative strength and Verbal is a relative weakness.

STUDENT NAME I.D. Number 1 I.D. Number 2 ABCDEF G H I J K L M NOPZ	Birth Date Age Program	Level Form	(Gender)		No. of Items	No. Att	Raw Score	USS	AGE SCORES SAS	PR	S	GRADE SCORES PR	S	LOCAL SCORES PR	S	Student Profile APR Graph (1 10 25 50 75 90 99)	Ability Profile
Gambosi, Olivia 0000146921	06/04 08-04	9 7	(F)	Verbal	62	62	26	174	93	33	4	27	4	41	5	33	5C (V-Q+)
				Quantitative	52	52	27	186	104	60	6	54	5	70	6	60	
				Nonverbal	56	56	30	188	102	55	5	53	5	63	6	55	
				Composite (VQN)				**183**	**99**	**48**	**5**	**41**	**5**	**53**	**5**		



Achievement Test Performance

The achievement test scores of students who have **C** profiles generally fall midway between the scores for the two corresponding **B** profiles. For example, students with the ability profile **4C (V+ Q–)** show achievement levels that are approximately midway between those shown by the students with **4B (V+)** and **4B (Q–)** profiles. This means that the consequences for achievement test scores for students with **C** profiles are smaller and less easily summarized than those for students with **B** profiles.

Adapting Instruction for Students with Mixed Ability Profiles

Students with **C** (mixed) ability profiles are the most challenging to assist with planned interventions. This challenge occurs because it is often difficult to know when particular instructional methods or materials will capitalize on the students' strengths or, instead, compensate for their weaknesses. For example, students who have difficulty creating and reasoning with mental models often perform much better if given a concrete model or a line drawing to work with when attempting to understand a problem. If the model or graphic is too complex, however, encoding it requires spatial reasoning that may exceed a student's capabilities.

The line between compensation for a weakness and capitalization on a strength is, therefore, often difficult to discern in advance. These effects differ across students depending on the complexity of the model, a student's familiarity with it, and the level of each student's spatial or figural reasoning abilities.

When a student has both a relative strength and a relative weakness, as in a **C** profile, it becomes very difficult to know how a given intervention will be perceived and processed by the student. Plan a strategy based on your knowledge of the student's learning preferences and challenges and your experience with the curricular materials.

Ultimately, the learners' ease and success as they try to navigate their way through a lesson, a unit, and, eventually, a course help you determine whether a strategy is working as planned. Therefore, although all learners should be encouraged to develop strategies for regulating their own learning, such self-monitoring and self-reflection are particularly important for students with mixed patterns of cognitive strengths and weaknesses.

Help these students understand that the process of learning, using, and then evaluating different strategies is similar to the process of trying on different articles of clothing to see how they fit. Explain that, like clothing, the strategy that fits best now may change as they mature or as the context varies.

Because mixed profiles cannot be summarized easily, users should look up particular C profiles on the *CogAT* Web site. You can access the Interactive Ability Profile Interpretation System, an online tool to interpret ability profiles of your choosing, at this website: www.cogat.com