The Cognitive Assessment System (Naglieri & Das, 1997) is an individually administered, norm-referenced test of cognitive processing. Within the authors' theory, intellectual functioning is the interaction between a person's store of basic knowledge and his or her ability to plan, pay attention, and process (simultaneously or successively). Naglieri (1999, p. 13) explains the major components of the theory in essentially this way: Planning is composed of developing a plan of action, monitoring its effectiveness, revising the plan as things change, and controlling impulses to act without careful consideration. Attention is focused, selective, and sustained on a particular activity. In simultaneous processing, an individual synthesizes all of the parts into a meaningful whole. In successive processing, an individual connects parts serially to form a chain or sequence of the parts. The CAS is composed of four components, each having 3 subtests. Administration of all 12 subtests is called the Standard Battery; administration of 8 subtests is called the Basic Battery.

**Planning Subtests**

**Matching Numbers** Each of the four items on this timed subtest consists of eight rows of six numbers each. The student is to find the two numbers in each row that are the same. The numbers range from one-digit integers to seven-digit integers. The rows of multidigit numbers were prepared in order to facilitate particular strategies; for example, each number in a row may start with a different integer or each number may end with one or
two different integers. Children between 5 and 7 years old are given the first two items; individuals between 8 and 17 years of age are administered the last three items. An item is scored as the number correct (of eight) divided by the number of seconds required to complete the item (or the maximum time). After the final item is administered, students are asked what strategy they used to find the identical integers. The subtest raw score is the rounded sum of the item raw scores; item raw scores are quotients of the square of the number correct plus 10 divided by the number of seconds (measured in three-second intervals).

**Planned Codes** There are two items on this timed subtest. On each item, a code associates Xs and Os with A, B, C, or D; for example, OX is associated with A on item 1. The test taker is to write the correct two-letter code for each letter. On the first item, the eight columns always contain the same letter and are in alphabetic sequence, with A following D (that is, A, B, C, D, A, B, C, D). Thus, the eight rows are identical. On the second item, the rows remain in alphabetical sequence, but the first letter is not always A. The letters are arranged so that a letter forms a diagonal. For example, the first row begins with A; A is the second letter in row two, the third letter in row 3, and so forth. After the last item in the subtest is completed, students are asked to explain how they completed the problem. The subtest raw score is the rounded sum of item raw scores; item raw scores are quotients of the square of the number correct plus 10 divided by the number of seconds (measured in three-second intervals).
**Planned Connections**  The eight items on this timed subtest require a student to connect lettered and/or numbered boxes sequentially. Children between 5 and 7 years old are given the first five items, which consist of numbers. Older children begin with item five and progress to items that require test takers to alternate between numbers and letters (for example, 1, A, 2, B, 3, C, and so forth). With the last item still exposed, test takers are asked to explain how they completed the problem. Raw scores are the total number of seconds needed to complete the items.

**Simultaneous Subtests**

**Nonverbal Matrices**  The 33 items on this untimed subtest require the selection of the one option that completes a relational matrix from an array of six choices. The raw score is the number of correct responses.

**Verbal–Spatial Relations**  The 27 items in this untimed subtest require the selection of the one option that answers a question read by the examiner from an array of six choices. A difficult item would be similar to this: Which picture shows an arrow over a circle in a square under a cross? The raw score is the number of correct responses.

**Figure Memory**  The 57 items on this untimed test each consist of two parts. The first part is a stimulus (geometric design), which is shown for five seconds. The second part is a more complicated geometric design in which the stimulus is embedded. Test takers
must trace the stimulus design in the embedded design. The raw score is the number of correct responses.

*Attention Subtests*

**Expressive Attention** For children from 5 to 7 years of age, the test items contain drawings of eight animals. Four animals depicted in the drawings are classified as large (for example, dinosaur and bear), and four are classified as small (for example, butterfly and mouse). Children are presented with an array of drawings of these animals and must say big or small for each. Children then must identify drawings of large animals as large, and drawings of small animals as small. On the test item, large animals are represented by small drawings, and small animals, by large drawings. For test takers who are 8 or older, the stimuli are colors or color names. Test takers first read the names of colors and name colors. On the test item, the names of colors are printed in different colors (for example the word *red* might be printed in blue ink). Test takers must name the color in which the word is printed (not read the word). The subtest raw score is the quotient of the square of the number correct plus 10, all divided by the number of seconds (measured in three-second intervals).

**Number Detection** Children from 5 to 7 years of age must determine if each number in a 10 by 18 array of single digits is one of three stimulus numbers. Test takers who are 8 or older must base their determination on both the integer and the style in which it is printed. The subtest raw score is the rounded quotient of the square of the number correct
less the number incorrect plus 10, divided by the number of seconds (measured in three-
second intervals).

**Receptive Attention** For children from 5 to 7 years of age, each item consists of ten rows
of five pairs of drawings. Children must underline the two drawings in a pair when they
are the same. Items that are more difficult require children to identify different examples
of the same concept as the same; for example, a Cape Cod–style house and a ranch-style
house are both houses. For test takers who are 8 or older, the stimuli are letters. On easier
items, the letter and case are the same. On more difficult items, test takers must recognize
that letters are the same whether they are upper- or lowercase; for example, r and R must
be recognized as the same, whereas R and S must be recognized as different. The subtest
raw score is the rounded quotient of the square of the number correct less the number
incorrect plus 10, divided by the number of seconds (measured in three-second intervals).

**Successive Subtests**

**Word Series** The 27 items on this subtest require the repetition of a series of two to nine
nouns spoken by the examiner at one-second intervals. The same nine nouns are used in
all 27 items. The raw score is the number of correct responses.

**Sentence Repetition** The 20 items on this subtest require the repetition of "sentences"
ranging from 3 to 19 words. Sentences are composed of color names used as verbs,
nouns, and adjectives—for example, "The blue yellowed the purple green." The raw score is the number of correct responses.

**Speech Rate**  This subtest is administered to children between 5 and 7 years of age. Each of the eight items consists of 3 one- or two-syllable words (for example, girl–dog–purple). Children must say the sequence correctly ten times as fast as they can within a maximum time of 30 seconds. Scores are based on the time it takes to repeat each sequence ten times. Raw scores are the total number of seconds needed to complete the items.

**Sentence Questions**  This subtest is administered to individuals 8 and older. The 21 items consist of declarative "sentences" composed of color names used as verbs, nouns, and adjectives. The examiner reads the sentence, and then asks a question—for example, "The red and blue browned the yellow; who browned the yellow?" The raw score is the number of correct responses.

**Scores**

For each age group, subtest raw scores are converted to scaled scores, which are standard scores (mean = 10 and standard deviation = 3) that have been normalized and smoothed. Subtest scaled scores are combined to obtain PASS Scale Scores (that is, scale scores for Planning, Attention, Simultaneous Processing, and Successive Processing); PASS Scale Scores have a mean of 100 (standard deviation = 15). The CAS (Standard) Full Scale is based on all 12 subtests, and the CAS (Basic) Full Scale does not include 4 subtests.
(Planned Connections, Figure Memory, Receptive Attention, and Speech Rate or Sentence Questions). Both Full Scales have a mean of 100 (standard deviation = 15).

Norms

The CAS was normed on 2,200 individuals (150 males and 150 females at each age) who were tested by 274 examiners at 68 sites from 1993 through 1996. At each age, the sample has appropriate proportions from each region of the country, with different levels of parental education, of Hispanic and non-Hispanic individuals, and of individuals who identify themselves racially as African American, Caucasian, or other. Although this is somewhat unclear, subjects apparently were located through schools. If so, the samples of children younger than 7 and older than 16 (who are not subject to compulsory attendance laws in many states) may be less representative.

Reliability

Corrected split-half reliabilities for the Simultaneous and Successive subtests are presented for each age. These reliability estimates range from .70 to .96; 18 of the 78 age \$ subtest coefficients equal or exceed .90. Test–retest correlations were used to estimate reliability of the subtests on the Planning and Attention Scales. These estimates range from .63 to .93; 3 of these 78 age \$ subtest coefficients equal or exceed .90. For the Basic Battery, the Planning and Attention Scales are reliable enough for screening. For only 2 (ages 5 and 6) of the 13 age groups do Planning reliabilities equal or exceed .90, and no
age group has an Attention reliability that equals or exceeds .90. On both the
Simultaneous and Successive Scales, 9 of the 13 reliability estimates equal or exceed .90.
Only 2 reliability estimates for the Full Scale Score equal or exceed .90. For the Standard
Battery, the Planning and Attention Scales continue to be less reliable than the
Simultaneous and Successive Scales. For only 3 of the 13 age groups do Planning
reliabilities equal or exceed .90; the same is true for Attention. The Simultaneous and
Successive Scales are generally reliable. At only 2 of 13 ages for the Simultaneous Scale
and 1 of 13 ages for the Successive Scale are reliability estimates less than .90. The
estimated reliabilities of the Standard Battery Full-Scale Score exceed .90 at all ages.

Additional information about the stability of standard scores is presented for 215
individuals in three age ranges: 5–7, 8–11, and 12–17. The retest interval ranged from 9
to 73 days; the median interval was 21 days. For children 5–7, the highest obtained
correlation was .88. There was a mean gain of 7 points (almost half a standard deviation)
between test and retest on the Full-Scale Score of the Standard Battery. For children 8–
11, only for the Full-Scale Scores on the Standard and Basic Batteries and the Successive
Scale on the Standard Battery did the test–retest correlation equal or exceed .90. The
mean gain between test and retest on the Full-Scale Score of the Standard Battery was 6
points. For adolescents 12–17, the highest obtained correlation was .89. There was a
mean gain of 5 points between test and retest on the Full-Scale Score of the Standard
Battery.

Given these estimates of reliability, the Basic Battery appears better suited for
screening and research purposes. Examiners using the Standard Battery should interpret
scores, especially on the Planning and Attention Scales, cautiously. The authors provide
tables that should greatly aid in the interpretation of CAS scores. They provide tables containing 90 and 95 percent confidence intervals for each CAS score. In addition, they provide tables for the significance and meaningfulness (that is, degree of unusualness) of the differences between each PASS Scale Score and the mean PASS Scale Score. Finally, they also provide tables for the significance and meaningfulness of differences between each subtest scaled score and the mean scaled score for the PASS Scale.

Validity

Evidence for the content validity of the CAS is problematic because many practitioners and scholars do not view cognitive processing as synonymous with intelligence. Indeed, most of the subtests assess behavior that is not usually assessed on other tests of intelligence. This is both a strength (CAS is different) and a weakness (CAS is really different).

Some evidence for the CAS's criterion-related validity is presented. In one study, the relationship between CAS Scale Scores and verbal and math scores on the Scholastic Aptitude Test (SAT) was examined. Planning and Attention are unrelated to SAT verbal scores; Successive Processing is unrelated to SAT math scores. The other correlations are significant, with the Full-Scale Score having the highest correlations with SAT verbal (.49) and math (.56). In another study, the relationship of scores on the CAS and two Wechsler scales was examined. With younger children, the Simultaneous and Successive Scales were well correlated with the three WPPSI-R IQs (r's ranged from .52 to .76). The CAS Full Scale was not significantly correlated with the PIQ, and the Planning and
Attention Scales were uncorrelated with any of the WPPSI-R IQs. The relationship between CAS Scale Scores and WISC-III scores was investigated with three different samples of students: students in general education, students with learning disabilities, and students with mental retardation. The WISC-III VIQ was not significantly correlated with Planning or Attention for general education students or students with mental retardation; the WISC-III PIQ was uncorrelated with Successive Processing for students with learning disabilities. All other correlations were significant.

The authors offer four types of evidence to support the CAS's construct validity. First, CAS scores increase with age. Second, the CAS predicts scores on the Woodcock–Johnson Revised Tests of Achievement. The Basic and Standard Full-Scale Scores correlate highly ($r$'s in the high .60s) with the WJ-R clusters and subtests, while individual scales correlate moderately ($r$'s typically in the .5 to .6 range). Third, groups of students with disabilities (that is, attention deficit hyperactivity disorder, mental retardation, traumatic brain injury, reading disability, and serious emotional disturbance) earn lower scores on some PASS Scales and subtests. However, the rationale for why these differences are meaningful is unclear in some instances. Finally, and most importantly, factor-analytic techniques generally support CAS's theoretical model. Depending on the statistical technique and age of the test takers, three or four factors underlie the CAS. Regardless of technique, Simultaneous and Successive Processing clearly emerge. Attention and Planning may or may not be distinct factors.

**Summary**
The Cognitive Assessment System is an individually administered, norm-referenced test of cognitive processing—that is planning, attending, simultaneous processing, and successive processing. The test consists of 12 subtests divided equally among the four processes. Subtest raw scores are converted to normalized scaled scores; subtest scaled scores are combined to obtain PASS Scale Scores and Full-Scale Scores with a mean of 100 ($\mu = 15$). The CAS (Standard) Full Scale is based on all 12 subtests, whereas the CAS (Basic) Full Scale does not include four subtests. At each age, CAS's normative sample has appropriate proportions of students from each region of the country, with different levels of parental education, and from different ethnic groups. The reliabilities of PASS Scale Scores on the Standard Battery are high enough to use in making important decisions on behalf of individual students. The Basic Battery appears better suited for screening purposes. Evidence for CAS's validity is difficult because the model of intelligence is so different from the models used by other tests of intelligence. Factor-analytic studies generally support the presence of four subscales that appear to be measuring the intended abilities. CAS does correlate well with other intelligence measures, and it does predict scores on standardized achievement tests.