CHAPTER 13

The Differential Ability Scales—Second Edition

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Psychometric assessment is one of the finer achievements of the discipline of psychology in the last 100 years. The second edition of the Differential Ability Scales (DAS-II; Elliott, 2007a) follows this tradition, and is a development of the first edition of the instrument (DAS; Elliott, 1990a). This widely used battery of tests was developed and standardized in the United States for the assessment of the cognitive abilities of children between the ages of 2 years, 6 months and 17 years, 11 months (2:6–17:11). It has a longer history than its publication date suggests, however, as it is based on a predecessor, the British Ability Scales (BAS; Elliott, 1983a, 1983b). In its turn, the BAS incorporated new features from the DAS in its second edition (BAS II; Elliott, 1996).

As its name suggests, the DAS-II was developed with a primary focus on diverse, specific abilities rather than on general "intelligence."

STRUCTURE OF THE DAS-II

The DAS-II consists of 20 individually administered subtests divided into two overlapping batteries. The Early Years battery is normed for children ages 2:6–8:11. The School-Age battery is normed for children ages 5:0–17:11. Thus the Early Years and School-Age batteries were co-normed on children ages 5:0–8:11. The overlap provides us with important advantages in terms of out-of-level testing because examiners assessing bright younger children or less able older ones are enabled to select a battery containing subtests that are appropriate for the children's ability and level of cognitive development.

Six core subtests in each battery contribute to a composite score—General Conceptual Ability (GCA), focused on reasoning and conceptual abilities; a Special Nonverbal Composite (SNC); and three lower-level composite scores called *cluster scores*. All the core subtests are highly *g*-saturated.

In addition to the core subtests, up to 10 diagnostic subtests are available for children taking the Early Years battery, and up to 8 are available for those taking the School-Age battery. These diagnostic subtests yield three additional cluster scores and also measure other specific abilities that do not contribute to the composites.

Note that the youngest children (ages 2:6–3:5) take a more limited range of subtests. This age range is called the Early Years (Lower Level), and the 3:6–8:11 range is called the Early Years (Upper Level). The overall structure is summarized in Table 13.1.

CLINICAL AND THEORETICAL UNDERPINNINGS

Users of cognitive ability tests typically compare an individual's performance and responses with those of a representative population sample of the

TABLE 13.1. Number of DAS-II Subtests and Composites in Each Battery

Battery	Number of subtests	General composite	Cluster scores
Early Years (Lower Level), ages 2:6–3:5	4 core 3 diagnostic	1. GCA 2. SNC	
Early Years (Upper Level), ages 3:6–8:11	6 core 10 diagnostic	1. GCA 2. SNC	*Core clusters* 1. Verbal 2. Nonverbal Reasoning 3. Spatial *Diagnostic clusters* 4. School Readiness 5. Working Memory 6. Processing Speed
School-Age, ages 5:0–17:11	6 core 8 diagnostic	1. GCA 2. SNC	*Core Clusters* 1. Verbal 2. Nonverbal Reasoning 3. Spatial Ability *Diagnostic clusters* 4. Working Memory 5. Processing Speed

Note. GCA, General Conceptual Ability; SNC, Special Nonverbal Composite.

same age as the person being tested. Paradoxically, however, while test scores are nearly always compared with the norm, the children, students, or adults whom we assess are often extremely atypical. The bread-and-butter work of a psychologist or psychological examiner involves individuals who are having difficulties or are failing to learn under normal conditions, or whose behavior gives cause for concern.

Because the individuals who are typically referred to psychologists manifestly have a huge range of individual special needs, the *clinical* priorities in the development of the DAS-II and its predecessors have been as follows:

1. Many children referred for psychological assessment have a history of problems with attending to adult instruction (i.e., a significant number of them will be distractible). For such children, test materials need to be varied and engaging, using different formats and types of tasks. A uniform approach to the administration of all subtests (e.g., using easels) has always been deliberately avoided in the DAS-II and its predecessors, in the interest of engaging children with variety.

2. Because many low-functioning children are likely to be assessed, there need to be plenty of test items that afford an opportunity for teaching and demonstrating what is required in each task. This is to ensure as far as possible that the children who are being assessed understand what they are supposed to be doing. Young children, and children with developmental disabilities and learning disabilities (LDs), often have difficulty in "warming up" to a task and initially understanding the task requirements. For this reason, most of the DAS-II subtests have demonstration and teaching procedures built into the administration. Such teaching items enable an examiner to tell a child that he or she is correct (if this is the case), and if the item has been failed, to give and explain the correct response or solution.

3. Again, because many low-functioning children are likely to be assessed with the DAS-II, its subtests have been designed to have low floors. A floor effect in test norms is shown when a group of individuals in an age group all get raw scores of 0 or 1 point on the test. Such individuals find even the easiest items in the test to be too difficult, and thus the test cannot discriminate among them. This results in the normative scores' being *inflated* for those who obtain such low raw scores. For example, if, say 10% of children in an age group obtain a raw score of 0 on a test, standard scores cannot reasonably go below 80. So a child who is actually at the 1st percentile in relation to his or her age group does not get a standard score that reflects this (i.e., a score of about 65), but instead gets a score of about 80. Later tables will show that the DAS-II subtests and composites have low floors.

4. Because many children have had considerable experience of failing tasks set them by adults, the tests should minimize children's experience of failure to the greatest possible extent, and should maximize their enjoyment in success. The *item set* approach to test administration, which is used throughout the DAS-II, meets this objective. This approach is unique to the DAS-II and all its predecessors.

5. At a practical level, the item set approach has two major additional advantages. First, it keeps the testing session moving briskly, with subtests ending and new ones starting more quickly than if traditional administration methods were employed. This has a positive impact on children's motivation and willingness to remain in the test situation. The second advantage is for the examiner: The battery is relatively quick to administer. The Early Years battery has a median administration time for the core subtests of 31 minutes or less, while the core subtests of the School-Age battery have a median administration time of less than 40 minutes.

6. The normative overlap between the Early Years and School-Age batteries, described earlier, is 1 year wider than it was in the first edition, and is designed to enable examiners to assess children whose developmental level is atypical for their age. Thus the Early Years battery may be given to children up to the age of 8:11, yielding composite scores with identical interpretation to those in the School-Age battery, if it is determined by the examiner that the Early Years materials are developmentally more appropriate for a child.

7. Out-of-level testing procedures and an extended GCA (taking the lowest GCA score down to 25) are provided for children with LDs and developmental disabilities. Again, therefore, a school-age child may be assessed with the Early Years materials if these are considered by the examiner to be more developmentally appropriate. These procedures are described in detail elsewhere (Dumont, Willis, & Elliott, 2009).

8. Finally, because professionals assessing children with LDs and developmental disabilities need information at a finer level of detail than an IQ score, the DAS-II and its predecessors were designed to reflect modern knowledge on the nature and structure of cognitive abilities. A pattern of *strengths and weaknesses* (PSW) approach to assessing LDs has been broadly accepted by many professionals and by the U.S. government (Individuals with Disabilities Education Improvement Act of 2004 [IDEA 2004]; Daniel, Breaux, & Frey, 2010; Hale & Fiorello, 2004). Because the DAS-II incorporates such an approach, examiners using it may obtain measures of seven broad abilities and a range of narrow abilities that reflect current theory on the structure of human cognitive abilities. This is discussed further below.

The major *technical* priority in the development of both the original DAS and the DAS-II has been to produce a battery in which subtests and cluster scores are individually interpretable. For this, they need to have substantial reliability and need to be distinctive measures of different cognitive functions. The high specificity of the DAS-II subtests and clusters (see later discussion in this chapter), which supports such interpretations of specific abilities, is a distinguishing feature of the battery.

What of the *theoretical* model? When the many theories of the structure of abilities were reviewed at the time of the DAS's initial development in the early 1980s, it was apparent that no single theory was entirely persuasive, and certainly no single theory had universal acceptance among theoreticians or practitioners. Because of this, the original DAS (and the original BAS on which it was based) were not developed solely to reflect a single model of cognitive abilities, but reflected an eclectic number of theoretical perspectives. They were designed to address processes that often underlie children's difficulties in learning, as well as what we then knew about the neurological structures underlying these abilities.

During the years since the original DAS was published, a growing consensus has developed among factor theorists of human abilities. This centers on what became widely referred to as Gf-Gc theory, after the initial theory development by Cattell (1971) and Horn (Cattell & Horn, 1978; Horn & Blankson, Chapter 3, this volume; Horn & Noll, 1997). The basic theory—that variance among multiple measures of cognitive ability can be accounted for by numerous first-order, narrow abilities and 8–10 broad, second-order factors—was also demonstrated by Carroll (1993, 2003; see also Carroll, Appendix, this volume), who showed that there are considerable similarities in the factor structures of cognitive test batteries. The contributions to this volume by Carroll and by Horn and Blankson make explicit the disagreement between Carroll and Horn about the reality of the general factor, *g*; Carroll supported the construct, whereas Horn considered it to be a statistical artifact. Other than this disagreement, the similarities in the factors described by these two authors are considerable and impressive.

Because of the convergence between Carroll's and Horn's theoretical positions on the hierarchical structure of human abilities, Gf-Gc theory has more recently been referred to as Cattell–Horn–Carroll (CHC) theory (McGrew, 2005; see Schneider & McGrew, Chapter 4, this volume). It also appears to be a unifying theory about which most workers in the area of the structure of human abilities broadly agree (Schneider & McGrew, Chapter 4, this volume). As a result of the development of CHC theory, and before development of the DAS-II began, McGrew (1997), McGrew and Flanagan (1998), Flanagan, McGrew, and Ortiz (2000), Alfonso, Flanagan, and Radwan (2005), and Elliott (2005) were making links between CHC theory and findings on the factor structure of the DAS. And interestingly, at about the same time as the DAS-II was published, Sanders, McIntosh, Dunham, Rothlisberg, and Finch (2007) reported a joint factor analysis of the DAS and the Woodcock–Johnson III Tests of Cognitive Abilities (WJ III COG; Woodcock, McGrew, & Mather, 2001b). Sanders et al. concluded that a three-stratum model provided the best fit to the data, with the DAS subtests measuring six of seven CHC broad ability factors.

Because of these theoretical developments, it was decided that the new DAS-II would be linked to CHC theory. Accordingly, all subtests are classified as measures of both narrow and broad CHC abilities. With one exception, all cluster scores have CHC broad ability classifications. The exception is the School Readiness cluster in the DAS-II Early Years battery, which is formed from a combination of three subtests measuring different CHC factors. It appears likely that in the early years at school, most teachers teach visual matching, early number concepts, and phonological awareness—skills that are defined by three of the DAS-II subtests. These three subtests "hang together" and form a factor that has a pragmatic rather than a theoretical basis, and that may prove useful for examiners who assess children in the early school years.

CHC theory continues to be a work in progress concerning (1) the number of factors representing independent abilities in the model; (2) the precise nature of each factor (see, e.g., the Chapter 4 discussion by Schneider and McGrew on whether Rapid Naming tests measure the broad ability of Gs or Glr); and (3) whether and to what extent subtests from different test batteries that purport to measure a given factor actually do so (see Keith & Reynolds, Chapter 32, this volume).

ORGANIZATION AND FORMAT

Test Structure and Content

The subtests in the DAS-II Early Years (Upper Level) and School-Age cognitive batteries are listed in Tables 13.2 and 13.3. In each table, the subtests are grouped according to whether they are designated *core* subtests or *diagnostic* subtests. Each subtest has a brief description of the nature of its task, including its CHC broad ability classification. The core subtests are relatively strongly *g*-related and therefore measure complex processing and conceptual ability.

New Subtests and Clusters in the DAS-II

All subtests that were in the original DAS are included in the DAS-II. In addition, the DAS-II has four new subtests. Recall of Sequential Order and Recall of Digits—Backward form a new diagnostic Working Memory cluster. A new Rapid Naming subtest combines with Speed of Information Processing to form a new diagnostic Processing Speed cluster. And Phonological Processing has been introduced to reflect the research done on this ability in relation to reading disability since the DAS was first published.

Moreover, the Matrices subtest has been extended downward to age 3:6 with a new set of colored pictorial items suitable for young children, thereby enabling the DAS-II Nonverbal Reasoning cluster (a measure of Gf) to extend down to age 3:6.

To a reader familiar with the first edition of the DAS, it may appear that the Block Building subtest has been dropped from the DAS-II. In fact, Block Building has been merged into the Pattern Construction subtest, enabling that subtest now to extend down to age 2:6. Technically, it was found during development that the goodness of fit to the Rasch model of the Block Building items was excellent when they and the Pattern Construction items were both included in the analysis, and they could therefore be considered to measure the same latent dimension.

The School-Age core subtests are identical to those in the original DAS. Five of the Early Years core subtests are identical, the exception being that Early Number Concepts is now designated a diagnostic subtest; its place as a core subtest has

TABLE 13.2. Subtests of the DAS-II Early Years (Upper Level) Battery (Ages 3:6–8:11), Showing Abilities Measured (and Relation of Measures to Broad CHC Ability Factors) and Their Contribution to Composites

Subtest	Description	CHC broad ability	Contribution to composite
Core subtests			
Verbal Comprehension	Using various materials, child gives a motor response to verbal commands	Gc	Verbal, GCA
Naming Vocabulary	Child sees pictures of objects and names them	Gc	Verbal, GCA
Picture Similarities	Child selects a picture or figure closest to a target picture or figure	Gf	Nonverbal Reasoning, GCA, SNC
Matrices	Child selects a picture or figure that completes a 2 °2 or 3 °3 matrix	Gf	Nonverbal Reasoning, GCA, SNC
Pattern Construction	Child replicates designs, using blocks or foam squares	Gv	Spatial, GCA, SNC
Copying	Child copies figure by drawing it on paper	Gv	Spatial, GCA, SNC
Diagnostic subtests			
Recall of Objects—Immediate	Examiner presents 20 objects on card; child recalls as many as possible; three trials	Glr	
Recall of Objects—Delayed	Child recalls as many objects as possible 10–30 minutes after third exposure	Glr	
Early Number Concepts	Child responds to questions requiring prenumerical and numerical concepts	Gc/Gf[a]	School Readiness
Matching Letter-Like Forms	Child matches a target figure to one of six alternatives	Gv	School Readiness
Recognition of Pictures	Child identifies previously seen pictures embedded in a larger display	Gv	School Readiness
Phonological Processing	Child rhymes, blends, deletes, and identifies sounds in words	Ga	
Recall of Digits—Forward	Child repeats spoken single-digit sequences	Gsm	
Recall of Digits—Backward	Child repeats spoken single-digit sequences in reverse order	Gsm	Working Memory
Recall of Sequential Order	Child reorganizes and repeats spoken lists of body parts and objects in correct order	Gsm	Working Memory
Speed of Information Processing	Child quickly selects the largest number of squares or the highest number in a row	Gs	Processing Speed
Rapid Naming	Child quickly names colors, objects, or colors and objects in a visual display	Gs	Processing Speed

Note. GCA, General Conceptual Ability; SNC, Special Nonverbal Composite; Gv, visual–spatial processing; Gc, crystallized intelligence or verbal ability; Gf, fluid reasoning; Gsm, auditory short-term memory; Glr, long-term storage and retrieval; Ga, auditory processing; Gs, processing speed.

[a]Note that in the DAS-II handbook (Elliott, 2007c, pp. 60–61), Early Number Concepts is characterized as measuring a mixture of Gc and Gf. However, Keith et al. (2010) have argued that Early Number Concepts is best conceived as a measure of fluid reasoning and not crystallized intelligence for ages 5 through 8. It appears that the influence of Gf on this subtest becomes stronger with increasing age.

now been taken by the downward extension of Matrices. Some of the diagnostic subtests have a lower *g* saturation and measure such less cognitively complex functions as short-term memory and speed of information processing. However, the Working Memory subtests, the Phonological Processing subtest, and the Early Number Concepts subtests have substantial *g* loadings. Subtests have normative scores in a *T*-score metric (mean = 50, standard deviation [*SD*] = 10).

Tables 13.2 and 13.3 also show the composites that can be derived from each of the core and the diagnostic subtests. Two types of composites are provided, all in a standard score metric (mean = 100, *SD* = 15). First are lower-order cluster scores. From age 3:6 onward, the core subtests yield three

TABLE 13.3. Subtests of the DAS-II School-Age Battery (Ages 5:0–7:11), Showing Abilities Measured (and Relation of Measures to Broad CHC Ability Factors) and Their Contribution to Composites

Subtest	Description	CHC broad ability	Contribution to composite
Core subtests			
Word Definitions	Child tells the meaning of words given by the examiner	Gc	Verbal, GCA
Verbal Similarities	Child describes how three objects or concepts are similar	Gc	Verbal, GCA
Matrices	Child selects a picture or figure that completes a 2 °2 or 3 °3 matrix	Gf	Nonverbal Reasoning, GCA, SNC
Sequential and Quantitative Reasoning	Child completes a sequence of pictures, figures, or numbers	Gf	Nonverbal Reasoning, GCA, SNC
Pattern Construction	Child replicates designs, using blocks or foam squares	Gv	Spatial, GCA, SNC
Recall of Designs	Child draws figure after viewing it for 5 seconds	Gv	Spatial, GCA, SNC
Diagnostic subtests			
Recall of Objects—Immediate	Examiner presents 20 objects on card; child recalls as many as possible; three trials	Glr	
Recall of Objects—Delayed	Child recalls as many objects as possible 10–30 minutes after third exposure	Glr	
Recognition of Pictures	Child identifies previously seen pictures embedded in a larger display	Gv	
Phonological Processing	Child rhymes, blends, deletes, and identifies sounds in words	Ga	
Recall of Digits—Forward	Child repeats spoken single-digit sequences	Gsm	
Recall of Digits—Backward	Child repeats spoken single-digit sequences in reverse order	Gsm	Working Memory
Recall of Sequential Order	Child reorganizes and repeats spoken lists of body parts and objects in correct order	Gsm	Working Memory
Speed of Information Processing	Child quickly selects the largest number of squares or the highest number in a row	Gs	Processing Speed
Rapid Naming	Child quickly names colors, objects, or colors and objects in a visual display	Gs	Processing Speed

Note. GCA, General Conceptual Ability; SNC, Special Nonverbal Composite; Gv, visual–spatial processing; Gc, crystallized intelligence or verbal ability; Gf, fluid reasoning; Gsm, auditory short-term memory; Glr, long-term storage and retrieval; Ga, auditory processing; Gs, processing speed.

of these across the board in both Early Years and the School-Age batteries (Verbal, Nonverbal Reasoning, and Spatial). Three clusters are also derived from the diagnostic subtests (School Readiness, Working Memory, and Processing Speed). For the youngest children at the Lower Level of the Early Years battery (ages 2:6–3:5), there are just two cluster scores, Verbal and Nonverbal.

Both batteries provide two higher-order composites. For most children, the most general composite will be the GCA score. For children for whom it is judged that the verbal component of that score is inappropriate, the SNC score is provided. For the Early Years (Lower Level), this is identical to the lower-order Nonverbal cluster, formed from two subtests. For the Early Years (Upper Level) and School-Age batteries, this is formed from the four subtests in the Nonverbal Reasoning and Spatial clusters.

One major change from the first edition of the DAS is that achievement tests are no longer part of the DAS-II battery. Instead, scores from the Wechsler Individual Achievement Test—Second Edition (WIAT-II; Psychological Corporation, 2001) have been linked to the DAS-II. In addition, correlational data have been provided between the DAS-II and the Kaufman Test of Educational Achievement—Second Edition (KTEA-II; Kaufman & Kaufman, 2004), and between the DAS-II and the WJ III Tests of Achievement (WJ III ACH; Woodcock, McGrew, & Mather, 2001a). Discrepancies between ability (as measured by the DAS-II GCA or SNC) and WIAT-II achievement may be evaluated by taking either (1) the simple difference between the achievement score and the composite, or (2) the difference between predicted and observed achievement, with predicted achievement being based on the GCA or SNC score. The DAS-II norms manual (Elliott, 2007d) provides information on the statistical significance of discrepancies (i.e., their reliability), and also their frequency of occurrence (or unusualness) in the standardization sample. Dumont and colleagues (2009) provide similar tables concerning the comparison of the DAS-II with the KTEA-II and the WJ III ACH.

Subtests as Specific Ability Measures

The chief aim in designing the content of the DAS-II was to produce subtests that are individually interpretable and can stand technically as separate, specific measures of various abilities. Once a specification was made of the desired tasks and dimensions to be measured, each subtest was designed to be unidimensional and homogeneous in content and distinct from other subtests, thus aiding the interpretation of children's performance. If a subtest score is to be interpreted as a measure of a specific, identifiable ability, the items within that subtest must be of similar content and must require the examinee to perform similar operations. For example, in each item of the Naming Vocabulary subtest, a child is asked to name an object in a picture. All items are therefore homogeneous. Naming Vocabulary is distinct from Verbal Comprehension, another verbal subtest, because the former requires a verbal response and the latter does not.

Ideally, each subtest should be a clearly interpretable measure of a CHC narrow ability factor, and the clusters to which the subtests contribute should also be clearly interpretable measures of CHC broad ability factors. Subtests or clusters should not sit astride two factors, as it were, so that the interpretation of a child's performance becomes unclear (see "Factor Structure," below).

In addition to having homogeneous content that focuses on a distinct ability, each subtest should also be reliable. Because the DAS-II emphasizes the identification of cognitive strengths and weaknesses, subtests must have a sufficient amount of reliable specificity to be separately interpretable (see "Accuracy, Reliability, and Specificity," below).

Verbal Content

Although it was considered important to include measures of verbal ability in the DAS-II cognitive battery, too many verbal tasks would present problems for examiners wishing to assess children from multicultural or culturally disadvantaged backgrounds. Because of these considerations, measures of general knowledge, colloquialisms, or words with a specific meaning in the United States were eliminated as far as possible.

Because verbal abilities are a major component of cognition, it is certainly necessary to have some subtests that are purely verbally presented, particularly at the School-Age level. However, getting the balance right in a test battery is important, too. In development of the DAS-II content, only two core subtests were included with entirely verbal presentation and response (both at the School-Age level), plus the two verbally administered Recall of

Digits subtests. Other than those subtests, the aim was to have subtests with varied tasks and materials. The "Test Materials" section below shows the range and variety of DAS-II stimulus materials.

Timed or Speeded Items

The DAS-II contains a diagnostic cluster called Processing Speed, contributed to by the Speed of Information Processing and Rapid Naming subtests, which are both timed. Apart from these two subtests, the DAS-II content minimizes the use of timed or speeded items. Of the other subtests, only one—Pattern Construction—gives extra points for correct completion of the designs within specified time limits. Of course, this feature of the subtest, which is appropriate for most individuals, is inappropriate for some children. Speed of response to the Pattern Construction items may not produce a valid measure for a child with a physical disability such as cerebral palsy, or one with an attentional problem, or one who takes an extremely deliberate approach to a task. For such children, an alternative procedure is provided, in which the score is based solely on accuracy within very liberal time limits. Confirmatory factor analyses (CFAs) reported in the DAS handbook demonstrated the factorial equivalence of the standard and alternative versions of Pattern Construction, which are unchanged in the DAS-II.

Test Materials

The DAS-II test kit includes three informational volumes: an administration and scoring manual (Elliott, 2007b), an introductory and technical handbook (Elliott, 2007c), and a manual of norms (Elliott, 2007d). Separate record forms are provided for the Early Years and School-Age batteries. The kit contains four stimulus books, as well as a variety of consumable booklets and manipulable materials. Materials vary for each subtest. The materials were specifically designed to be colorful, varied and engaging for children and students of all developmental levels, while being also easy to administer.

In the Early Years battery, only one subtest, Recall of Digits, is purely verbally presented, with no additional stimulus materials. In the School-Age battery, four subtests are purely verbally presented, with no additional stimulus materials. These are Word Definitions and Verbal Similarities, which constitute the Verbal cluster, and Recall of Digits—Forward and Recall of Digits—Backward, which measure aspects of verbal memory.

Translations

The DAS-II handbook (Elliott, 2007c, pp. 210–218) contains guidelines for the assessment of children with communication difficulties due to such causes as cultural differences, lack of proficiency in spoken English, and hearing impairments. To assist in assessing such children, the DAS-II has been published with two translations: Spanish and American Sign Language (ASL).

The manual contains an appendix in which are given the Spanish-language instructions needed to administer the subtests that do not require a verbal response from the child. The translated instructions are for the following Early Years core subtests: Copying, Matrices, Pattern Construction, and Picture Similarities. These subtests enable the Nonverbal Reasoning and Spatial cluster scores to be estimated, together with the SNC as a measure of *g*. For the School-Age battery, translated instructions are provided for Matrices, Pattern Construction, Recall of Designs, and Sequential and Quantitative Reasoning. Once again, these enable Nonverbal Reasoning, Spatial, and SNC scores to be obtained. Translations are also provided for the following diagnostic subtests: Matching Letter-Like Forms, Recognition of Pictures, and Speed of Information Processing.

The DAS-II kit includes a CD-ROM of signed administration directions in ASL for nine subtests. These include the same core subtests for the Early Years and the School-Age batteries as in the Spanish translation, thereby enabling Nonverbal Reasoning and Spatial cluster scores to be estimated, together with the SNC. In addition, three diagnostic subtests have been translated into ASL: Matching Letter-Like Forms, Recognition of Pictures, and Speed of Information Processing.

PSYCHOMETRIC PROPERTIES

The DAS-II standardization sample, the norming procedures, and data on the reliability and validity of the battery are by now well known, and are described elsewhere (Elliott, 2007c). The DAS-II followed essentially the same procedures in sampling, and in obtaining a substantial bias oversample, that were employed in the standardization of the DAS (Elliott, 1990b, 1997).

TABLE 13.4. Subtest Floors for the DAS-II Early Years (Lower Level) Battery: *T* Scores, *z* Scores, and Percentiles Produced by a Raw Score of 1 on Each Subtest for Children Ages 2:6–2:9

Clusters and subtests	*T* score	*z* score	Percentile
Verbal cluster			
Verbal Comprehension	24	–2.6	0.5
Naming Vocabulary	24	–2.6	0.5
Nonverbal cluster			
Picture Similarities	30	–2.0	2
Pattern Construction	27	–2.3	1

Subtest Floors

As explained earlier, because many low-functioning children are likely to be assessed with the DAS-II, its subtests have been designed to have low floors.

Table 13.4 shows the *T* scores, *z* scores (showing the number of standard deviations below the mean), and percentiles for a raw score of 1 on each of the four core subtests at ages 2:6–2:9, which is the lowest age group for the Early Years (Lower Level). If a child of this age happened to obtain raw scores of 1 on every subtest, this would yield standard scores of 56 and 64 on the Verbal and Nonverbal clusters, respectively, and a GCA score of 58. These three scores are at or below the 1st percentile. Clearly, because of the development of abilities in childhood, the floors of the subtests are lower than those in the table for children between the ages of 2:10 and 3:5, with lower values in the table, and with lower cluster and GCA scores.

Similarly, Table 13.5 shows the floors for children at ages 3:6–3:9—the lowest age group for the Early Years (Upper Level). These are for the six core subtests, which yield three cluster scores. Note that the two subtests that start at age 3:6 have the highest *T* scores for a raw score of 1. If a very low-functioning child were unable to understand these subtests, it is still possible to give the subtests from the Early Years (Lower Level) battery to obtain estimates of Verbal and Nonverbal ability, together with the GCA. If a child age 3:6 obtained raw scores of 1 on all six subtests, this would yield cluster standard scores of 39 (Verbal), 61 (Nonverbal Reasoning), and 60 (Spatial), with a GCA score of 47. All these scores would indicate that the child's ability in each area was below the 1st percentile.

Finally, Table 13.6 shows the floors of the DAS-II Early Years and School-Age batteries for children ages 7:0–7:5. At this age, the School-Age battery

TABLE 13.5. Subtest Floors for the DAS-II Early Years (Upper Level) Battery: *T* Scores, *z* Scores, and Percentiles Produced by a Raw Score of 1 on Each Subtest for Children Ages 3:6–3:9

Clusters and subtests	*T* score	*z* score	Percentile
Verbal cluster			
Verbal Comprehension	14	–3.6	<0.1
Naming Vocabulary	15	–3.5	<0.1
Nonverbal Reasoning cluster			
Picture Similarities	21	–2.9	0.2
Matrices	31	–1.9	3
Spatial cluster			
Copying	32	–1.8	4
Pattern Construction	18	–3.2	<0.1

would normally be given. On this battery, three of the six core subtests and three diagnostic subtests have *T* scores above the lowest possible level of 10. The *z* scores and percentile columns show that if a child obtained a raw score of 1 on any of these six subtests, he or she would be estimated to be at or below the 1st percentile for his or her age. The subtest *T* scores in Table 13.6 yield cluster standard scores as follows: Verbal, 44; Nonverbal Reasoning, 46; Spatial, 38; School Readiness, 37; Working Memory, 59; Processing Speed, 42; and GCA, 40. However, as discussed earlier, the normative overlap between the Early Years and School-Age batteries means that relatively low-functioning School-Age children ages 7:0–8:0 may be given the core subtests of the Early Years battery, which clearly has the lowest possible floors for children of that age—*T* scores of 10, four standard deviations below the mean for all subtests, which would yield a GCA score of 30.

The three age groups referred to in Tables 13.4, 13.5, and 13.6 are the lowest ages of children who

TABLE 13.6. Subtest Floors for the DAS-II Early Years and School-Age Batteries: *T* Scores, *z* Scores, and Percentiles Produced by a Raw Score of 1 on Each Subtest for Children Ages 7:0–7:5

Clusters and subtests	*T* score	*z* score	Percentile
School-Age battery			
Verbal cluster			
Word Definitions	23	–2.7	0.4
Verbal Similarities	10	–4.0	<0.1
Nonverbal Reasoning cluster			
Matrices	10	–4.0	<0.1
Seq. and Quant. Reasoning	25	–2.5	1
Spatial cluster			
Recall of Designs	16	–3.4	<0.1
Pattern Construction	10	–4.0	<0.1
Early Years (Upper Level) battery			
Verbal cluster			
Verbal Comprehension	10	–4.0	<0.1
Naming Vocabulary	10	–4.0	<0.1
Nonverbal Reasoning cluster			
Picture Similarities	10	–4.0	<0.1
Matrices	10	–4.0	<0.1
Spatial cluster			
Copying	10	–4.0	<0.1
Pattern Construction	10	–4.0	<0.1
Diagnostic clusters			
School Readiness			
Early Number Concepts	14	–3.6	<0.1
Matching Letter-Like Forms	10	–4.0	<0.1
Phonological Processing	10	–4.0	<0.1
Working Memory			
Recall of Sequential Order	24	–2.6	0.5
Recall of Digits—Backward	24	–2.6	0.5
Processing Speed			
Speed of Information Processing	27	–2.3	1
Rapid Naming	10	–4.0	<0.1

would normally be given the Early Years (Lower Level), the Early Years (Upper Level), and the School-Age batteries. Low-functioning children in these young age groups would be most likely to have the greatest difficulty with the easiest items, and would show the greatest floor effects. Children in older age groups would show lesser effects the older they became. The tables show that floor effects are minimal, and that one of the goals of test development—to provide subtests with low floors—has been met.

Accuracy and Reliability

The DAS-II uses what is termed an *item set* approach to test administration. This is a form of tailored testing that makes the assessment time-efficient while maintaining a high level of accuracy. This approach, and the procedures used in the DAS-II to achieve accuracy and reliability, are described in the DAS-II handbook (Elliott, 2007c) and in the first edition of this volume (Elliott, 1997).

Two diagnostic subtests (Recall of Objects—Immediate and Recognition of Pictures) have adequate mean internal-reliability coefficients of .79 at the Early Years level. All other Early Years subtests have internal reliabilities of .80 and above, nine of them being between .80 and .89, and five of them being .90 and over. At the School-Age level, Recognition of Pictures once again has an adequate but lower mean internal-reliability coefficient (.74) than other subtests. All other subtests have mean coefficients of .80 and above, nine of them being between .80 and .89, and six over .90.

The mean internal reliabilities of DAS-II cluster scores range from .89 to .95 for both the Early Years and School-Age levels. The mean internal reliabilities of the GCA and SNC are .95 (Early Years) and .96 (School-Age).

Without exception, the reliability coefficients improved for the DAS-II subtests retained from the first edition of the DAS; identical methods of estimation were used. Extensive further information on the reliability of the DAS-II is provided in the DAS-II handbook (Elliott, 2007c, pp. 121–140).

Specificity

The variance of test scores can be partitioned into a number of components. As described earlier, the *proportion of error variance* may be estimated and is defined as the value of 1 minus the reliability of a test. The *proportion of reliable variance* (i.e., the reliability of the test) may itself be partitioned into two components: *reliable common variance*, which is shared or overlapping with other tests in the battery, and *reliable specific variance*, which is not shared and does not overlap with other tests.

The proportion of common variance (often termed *communality*) may be estimated by the squared multiple correlation between a subtest and all others in the battery (Kaufman, 1979; Silverstein, 1976). The proportion of specific reliable variance is usually termed the *specificity* of a test and is estimated by subtracting the communality from the reliability coefficient of the test.

McGrew and Murphy (1995) consider test specificity to be high when it is (1) .25 or more (indicating that it accounts for 25% or more of the total variance of the test), and (2) greater than the proportion of error variance. Analyses of the specificity of the DAS-II (reported in detail in Elliott, 2007c, pp. 141–142) have shown every subtest to be of high specificity. For both the Early Years and the School-Age batteries, about 42% of subtest score variance is reliable specific variance. The range of subtest specificity is .31–.65 in the Early Years battery, and .31–.66 in the School-Age battery.

With one exception, the cluster scores in both batteries also show very high specificity, ranging from .37 to .57 (mean .47) for the Early Years battery and from .34 to .66 (mean .46) for the School-Age battery. The exception is the School Readiness cluster, which has a moderate specificity of .23 (falling just under the .25 criterion for high specificity). All subtest and cluster specificities substantially exceed the proportion of error variance.

Such values of specificity are very consistent with those previously found in the DAS and the BAS-II. These findings support the view that the original development goal of a battery with reliable, specific, individually interpretable subtests has been achieved. The results support the use of the DAS-II for the analysis of cognitive processing strengths and weaknesses.

Validity

The DAS-II handbook contains extensive information on the validity of the instrument. This can be broadly categorized into correlational studies, including CFAs of the structure of the battery, and studies on defined clinical samples of children with varying special needs. This section of the present chapter gives a brief description of studies on the factor structure of the DAS-II, and some data on the variety of significant strengths and weaknesses in cognitive abilities shown by children who are poor readers.

Factor Structure

The first edition of the DAS yielded only two cluster scores (Verbal and Nonverbal) at what was called the Upper Preschool level (now called the Upper Early Years battery). The downward extension of Matrices in the DAS-II was expected to produce three core cluster scores in the Early Years battery that would be equivalent to those in the School-Age battery—namely, Verbal (Gc), Nonverbal Reasoning (Gf), and Spatial (Gv).

The two new measures of working memory included in the DAS-II were also expected to form a cluster, and in addition it was thought that the new Rapid Naming subtest might cluster with Speed of Information Processing rather than with Phonological Processing when the final data were analyzed, as did similar subtests in the WJ III (McGrew & Woodcock, 2001). Thus it was anticipated that there would be two additional diagnostic clusters in the DAS-II—Working Memory and Processing Speed, measuring the CHC factors of Gsm and Gs, respectively.

Finally, the inclusion of the Phonological Processing subtest was expected to provide a measure of *auditory processing*—the CHC broad ability of Ga. This subtest would thereby fill a gap in the coverage of CHC broad ability factors that McGrew (1997, p. 160) noted in the original DAS. More importantly, it would also meet a clinical need for such a test that is relevant to reading acquisition and the assessment of reading disability.

Confirmatory Factor Analyses

Although the background of the DAS-II has remained eclectic, it was clear at the time of development that CHC theory had become the most dominant and widely accepted theory of the structure of human abilities. Accordingly, the DAS-II handbook (Elliott, 2007c) discusses the relation of the subtests and clusters to CHC theory in some detail. The major emphasis in conducting factor analyses was in using CFAs to test the correspondence of DAS-II subtests and clusters to the CHC model.

The DAS-II handbook contains details of the CFAs that were conducted to test the factor structure of the battery (Elliott, 2007c, pp. 153–162). The three clusters formed by the core subtests were confirmed as robust factors throughout the age range from 3:6 through 17:11. I have thus continued to call these clusters Verbal, Nonverbal Reasoning, and Spatial—names given them in the first edition of the DAS. In CHC terms, they measure the broad abilities of Gc (crystallized intelligence/knowledge), Gf (fluid reasoning), and Gv (visual–spatial ability), respectively.

Among the diagnostic subtests, a Working Memory factor was confirmed, formed by the subtests Recall of Digits—Forward, Recall of Digits—Backward, and Recall of Sequential Order. In CHC terms, this factor measures the broad ability of Gsm (short-term memory). This is clearly a *verbal* short-term memory factor because visual short-term memory tasks are always found under the G*v* factor. Moreover, because working memory tasks are cognitively more complex than simple digit recall, we found that the working memory subtests consistently had higher loadings on the factor than Recall of Digits—Forward. In order to avoid any ambiguity in interpretation (because Recall of Digits—Forward is *not* a measure of working memory), only the two working memory subtests form the Working Memory cluster in the DAS-II.

The CFAs also confirmed the Processing Speed factor, formed by the Speed of Information Processing and Rapid Naming subtests.

As an example of the analyses that were conducted, Figure 13.1 shows the factor structure of the DAS-II School-Age battery for children ages 6:0–12:11. This is the operating age range of the Phonological Processing subtest, and is the age range in which all seven CHC broad factors are found and confirmed. Figure 13.1 represents the final model (the full CHC model), which fits the standardization data significantly better than any alternative model of one, two, three, or five factors (Elliott, 2007c, p. 156).

The robustness of the structure across age levels was confirmed in an independent study by Keith, Low, Reynolds, Patel, and Ridley (2010), using both DAS-II batteries (Early Years and School-Age) across the 4- to 17-year age range. Two of these authors commented that this detailed study demonstrated remarkable consistency of the DAS-II with CHC theory (Keith & Reynolds, 2010, p. 638). The chief difference between this study and those reported in the DAS-II handbook is that Keith et al. dropped the Phonological Processing subtest from the analysis because it is the only representative of the CHC Ga factor in the battery.

Just as the Keith and colleagues (2010) study looked at the consistency and invariance of factor structure across a wide age range, so CFA was used

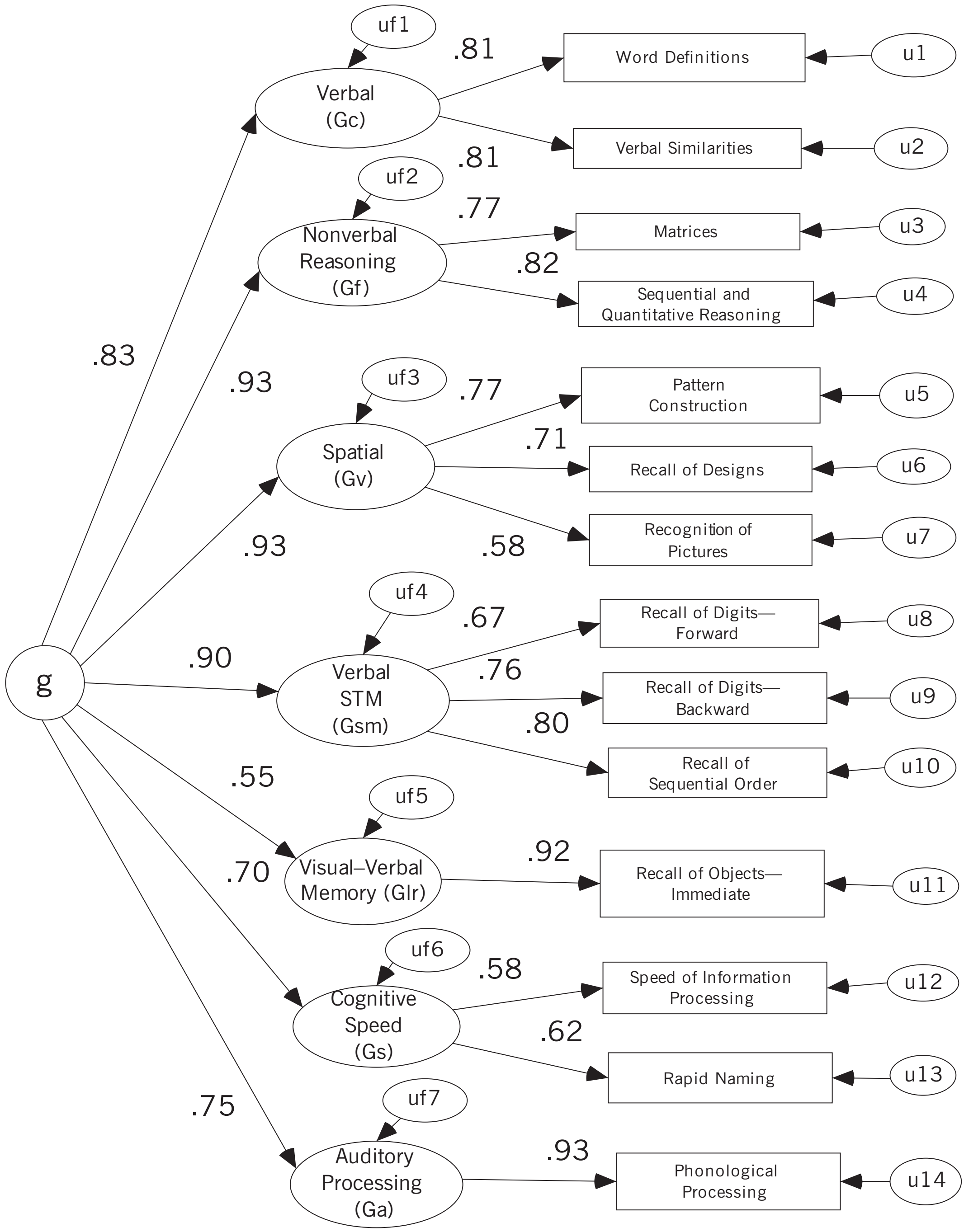

FIGURE 13.1. Factor structure of DAS-II School-Age battery for children ages 6:0–12:11, showing seven CHC broad ability factors.

to investigate construct bias in the instrument. A CFA study on the original DAS (Keith, Quirk, Schartzer, & Elliott, 1999) used the standardization sample and the bias oversample to test for construct bias. A hierarchical, multisample CFA was used to examine the constructs measured by the DAS in black, Hispanic, and white children. Results showed that the DAS measured the same constructs across all three ethnic groups across all age levels of the battery. The authors concluded that the DAS showed no construct bias, and that users of the battery could have confidence that the battery measures the same abilities for black, Hispanic, or white children and youth.

INTERPRETATION

Recommendations for Interpreting General, Broad, and Specific Cognitive Abilities

Chapters 4 and 5 in the DAS-II handbook (Elliott, 2007c) give detailed suggestions about cognitive processes underlying scores on the various DAS-II subtests and composites. The interpretive guidelines are largely (but not solely) based on the interpretation of subtests and clusters in terms of CHC broad and narrow abilities.

The DAS-II handbook also gives a systematic procedure for test interpretation. The procedure is partly based on the identification of scores that are significantly high or low at the .05 probability level. This is greatly facilitated by the design of the summary page of the record form, which shows the size of differences that are significant at $p < .05$ between achievement tests, composites, and subtest scores.

Other comparisons are made possible by tables in the DAS-II handbook. In particular, the handbook provides tables enabling discrepancies between observed and predicted achievement to be evaluated, as well as tables showing the frequency or unusualness of discrepancies. Because the development of interpretable subtests was a primary goal of the DAS-II, the handbook contains extensive interpretive guidelines for subtest scores.

Studies Conducted with Samples of Students with LDs

Research on DAS-II Score Profiles

DAS-II score profiles of 12 special populations have been reported in the handbook (Elliott, 2007b). Children were selected for each special group sample according to specified inclusion and exclusion criteria. These studies provided the means and standard deviations of standard scores of each group on each cluster and subtest. Although such studies are of some interest—particularly when relatively homogeneous groups are being studied, such as children who are gifted and talented, or those with mild to moderate intellectual disabilities—such studies can be misleading when applied to heterogeneous groups such as those with LDs, where there are likely to be a wide range of causal influences for the disorders, resulting in a wide range of score profiles.

This is illustrated in Table 13.7, which shows that students who were poor readers and those with an LD in math had a wide range of cognitive profiles on the DAS-II. First, a sample of 293 poor readers was drawn from the DAS-II standardization sample, together with extra individuals who were tested at the time of standardization. Some of these children were surplus to the sampling requirements of the project; others belonged to the special groups referred to above and also had an LD in literacy. All 293 poor readers showed a significant discrepancy between their obtained Word Reading scores on the WIAT-II and their predicted Word Reading scores based upon their GCA scores. The second sample of 43 children consisted of the special group of children who had been identified as having an LD in math.

Score profiles on the five DAS-II cluster scores were defined as follows:

- *Low Spatial, High Verbal*: The Verbal cluster score was significantly higher ($p < .05$) than the Spatial cluster. Also, the Nonverbal Reasoning score was intermediate, being lower than Verbal, and at or above the level of the Spatial score. This pattern might possibly suggest a nonverbal LD.
- *Low Verbal, High Spatial*: The Verbal cluster score was significantly lower than the Spatial cluster. Again, the Nonverbal Reasoning score was intermediate, being lower than Spatial, and at or above the level of the Verbal score. This has been a typically reported pattern for poor readers (e.g., British Psychological Society, 1999; Snow, Burns, & Griffin, 1998).
- *High Nonverbal Reasoning*: The Nonverbal Reasoning cluster score was higher than both the Verbal and Spatial scores, and significantly higher than at least one of them. This pattern might signify good ability to process complex auditory–visual information.

TABLE 13.7. Percentage of Students with Significantly High or Low Scores on DAS-II Clusters: Comparison of Poor Readers (*n* = 293), Those with LDs in Math (*n* = 43), and the Standardization Sample for Ages 6:0–17:11 (*N* = 2,600)

Type of profile	Poor readers (with significant discrepancy)	LDs in math	DAS-II standardization sample
No significant differences between clusters	14.3	14.0	11.5
Low Spatial, high Verbal	10.2	16.3	13.3
Low Verbal, high Spatial	17.1	7.0	13.3
High Nonverbal Reasoning	17.1	16.3	18.5
Low Nonverbal Reasoning	19.8	27.9	18.8
High Processing Speed	28.0	20.9	25.3
Low Processing Speed	22.2	34.9	25.0
High Working Memory	16.7	16.3	22.1
Low Working Memory	25.9	27.9	24.2

Note. The term *poor readers* refers to children with standard scores below 85 on WIAT-II Word Reading. The term *discrepancy* refers to the presence or absence of a statistically significant difference ($p < .05$) between obtained and predicted WIAT-II Word Reading scores (the prediction was based on the GCA score).

- *Low Nonverbal Reasoning*: The Nonverbal Reasoning cluster score was lower than both the Verbal and Spatial scores, and significantly lower than at least one of them. This core cluster profile might suggest difficulty in processing complex auditory–visual information. Elliott (2005) analyzed the scores obtained from various samples of children who had been identified as having an LD in reading, and reported that approximately one-third of them had this low Nonverbal Reasoning profile.
- *High Processing Speed*: The Processing Speed cluster score was significantly higher than the GCA score.
- *Low Processing Speed*: The Processing Speed cluster was significantly lower than the GCA score.
- *High Working Memory*: The Working Memory cluster score was significantly higher than the GCA score.
- *Low Working Memory*: The Working Memory cluster score was significantly lower than the GCA score.

Table 13.7 shows the percentage of children in each sample who showed each profile. The table also shows the frequency of each profile in the total DAS-II standardization sample for ages 6:0 through 17:11. What we can conclude from an initial inspection of these profile frequencies is that there was no common profile for poor readers or for children with an LD in math. Some children in each sample clearly had profiles that were the exact opposites of those shown by other children in the same sample.

Table 13.7 indicates that over 85% of children in the population would be expected to have one or more significantly high or significantly low cluster scores. There are also interesting differences in profile frequencies between the two samples of poor achievers.

It should be noted that the poor readers were in general *not* children who had been formally identified as having an LD in reading. About 20% had the low Nonverbal Reasoning profile previously reported to have been found in about one-third of previous samples who had an LD in reading. However, over a quarter of the sample with an LD in math had such a profile. Also, about one-third of the children in this sample also had significantly low Processing Speed scores, while very few (7%) had high Spatial ability. Both samples had a higher percentage of children with significantly low Working Memory than those with high Working Memory.

It appears that there are a number of contrasting subgroups within each group of children with reading or math difficulties. If one subgroup has significantly low mean scores on a DAS-II cluster, and the other subgroup has significantly high ones on the same cluster, the resulting mean for the total group would be attenuated, tending toward some midvalue. Correlations between this cluster and other variables would also be attenuated. Despite such likely problems, correlational studies have been conducted on samples of children with achievement problems in reading and math.

Correlational Studies

The interpretation of intelligence tests has been and remains one of the most controversial and divisive issues in cognitive assessment. Some authors (e.g., Canivez & Watkins, 1998; Glutting, McDermott, Konold, Snelbaker, & Watkins, 1998; Glutting, Watkins, Konold, & McDermott, 2006; Kahana, Youngstrom, & Glutting, 2002; Kotz, Watkins, & McDermott, 2008) dispute the validity and utility of patterns of performance, and affirm that there is little value in interpreting cognitive scores beyond a global ability estimate such as IQ or GCA.

Forty years of work on the development of the DAS-II and its predecessors run counter to this suggestion. Statistically significant intraindividual differences between subtest and cluster scores are, by definition, reliable; they indicate the presence of strengths and weaknesses in processing information that are not artifacts of measurement error. The DAS and the DAS-II standardization data indicate that a large proportion of children show such differences (see Table 13.7). The *raison d'être* of the DAS-II is that significant intraindividual differences between cluster and subtest scores should lead us to consider whether and how they illuminate processing strengths and weaknesses that may be related to the problem for which the child has been referred for assessment.

The evidence in favor of this approach is strong. CFAs conducted on the DAS-II standardization data, reviewed above, show that a model with multiple factors fits the data highly significantly better than a single-factor *g* model. The analyses demonstrate that the general factor *g* is not sufficient to explain the relationships between the subtests and clusters. Similarly, Vanderwood, McGrew, Flanagan, and Keith (2001) showed that specific cognitive abilities provide a better-fitting model for predicting reading achievement than does general cognitive ability.

Additional evidence on these issues has been provided by two studies, summarized below, which used the DAS-II (Elliott, Hale, Fiorello, Dorvil, & Moldovan, 2010; Hale et al., 2008). Interested readers can also see references in these articles to methodological criticisms of the Glutting, Watkins, and McDermott group's use of multicollinear data sets.

Prediction of WIAT-II Math Scores

Hale and colleagues (2008) used regression commonality analysis to examine the unique and shared variance components among DAS-II CHC factors in the prediction of WIAT-II Numerical Operations and Math Reasoning skills for the DAS-II normative sample and for a sample of children with a math LD. Because of the likely attenuation of correlations, it is possible (even probable) that this would reduce the number of variables found to have significant interrelationships. However, it was considered to be important to demonstrate, even from correlational data derived from heterogeneous samples, that the broad and narrow abilities represented in the DAS-II clusters and subtests would explain significantly more variance in math achievement than the GCA alone.

Results showed that the DAS-II predictors accounted for more achievement variance in typical children than in children with a math LD. The reason for this is very likely to be a restriction of range in the Math scores of the latter group. For typical children, DAS-II predictors accounted for 46% of variance in Numerical Operations and 58% of variance in Math Reasoning. On the other hand, the DAS-II predictors accounted for 33% of variance in Numerical Operations and 50% of variance in Math Reasoning for the children with a math LD. There was substantial loss of predictive validity when the GCA was used instead of cluster or subtest scores—13% loss for the typical group on both math tests, and 56% loss on Numerical Operations and 20% loss on Math Reasoning for the group with a math LD.

Prediction of WIAT-II Reading Scores

We (Elliott et al., 2010) used both commonality analysis and structural equation modeling (SEM) to investigate the effect of broad CHC abilities measured by the DAS-II, together with the effect of the general factor (*g*) on reading achievement measured by the WIAT-II.

The SEM analyses indicated that for typical children drawn from the standardization sample, four CHC-related measures were significant direct predictors of Reading Decoding (a combination of WIAT-II Word Reading and Pseudoword Decoding). These predictors were the Verbal (Gc), Nonverbal Reasoning (Gf), and Working Memory (Gsm) clusters, together with the Phonological Processing (Ga) subtest.

A similar analysis was conducted for a sample of 230 poor readers drawn from the standardization sample; children who were tested for standardization but who were surplus to requirements; and children with reading disorder, reading and written expression disorder, mathematics disorder, attention-deficit/hyperactivity disorder (ADHD), or ADHD with LD—samples gathered for studies of special populations at the time of standardization, and referred to above. For this sample, Phonological Processing was again found to be a significant predictor, together with the Spatial Ability (Gv) and Processing Speed (Gs) clusters, and the Recall of Objects—Immediate subtest (Glr).

Although Phonological Processing had a significant large effect on Reading Decoding for both samples, no other effects were significant for both samples. Each sample had three significant but different CHC factors that produced significant effects on Reading Decoding. When both analyses were considered together, the results showed that *every* CHC broad ability factor was a significant predictor in one or the other analysis. In both analyses, the effect of the general factor (*g*) was indirect. In other words, its effect was mediated through the three first-order factors measuring it (Verbal, Nonverbal Reasoning, and Spatial). The results demonstrated that children with reading problems have different cognitive predictor–reading achievement relationships than adequate readers.

The commonality analyses examined DAS-II predictors of WIAT-II Word Reading and Reading Comprehension scores. Once again, as might be expected, different commonalities were found for the typical sample and a sample of children with a specific learning disability in reading. Across all analyses, Verbal Ability (Gc), Nonverbal Reasoning Ability (Gf), Spatial Ability (Gv), Working Memory (Gsm), and Phonological Processing (Ga) showed important and significant effects, and explained significant amounts of variance over and above that explained by estimates of *g*.

The data from the studies on both math and reading suggested that practitioners should not emphasize global GCA, but should instead interpret cluster and subtest scores and their interrelationships in developing hypotheses about an individual's processing strengths and weaknesses.

BRIEF CASE STUDY

John (age 7:11), a white male in grade 2, was referred for assessment when his student assistance team reported their concern that he had not responded to the reading interventions provided as part of his regular instructional program. He struggled to name high-frequency words, and needed additional targeted instructional recommendations.[1]

John's achievement scores on the WIAT-II and his cognitive ability scores on the DAS-II are shown in Table 13.8. Examination of his WIAT-II scores shows that he has a specific difficulty with Word Reading. His higher score on Pseudoword Decoding suggests that he finds decoding regular words easier than irregular words. Such irregular words make demands on visual memory; they are often called *sight words* because they have to be remembered as a whole rather than being solvable phonetically. The initial hypothesis is that John may have visual information-processing difficulties.

On the DAS-II, the core clusters show a significant difference between Nonverbal Reasoning and both of the other clusters. Any hypothesis concerning poor processing of purely visual information is disconfirmed by John's Spatial cluster score, which is average, and at the same level as his Verbal cluster score. The subtests within each cluster have consistent scores, so the cluster scores may be interpreted without further qualification. Because of John's significantly low Nonverbal Reasoning score, it makes little sense to report his GCA score, which has little or nothing to offer in terms of describing John's cognitive processing.

The DAS-II Nonverbal Reasoning tasks are called *nonverbal* because they are presented visually. However, to solve the problems effectively, the individual needs to use internal language to encode the components of the visual stimulus, and to generate hypotheses, to test them, and to identify the correct solution. These tasks are therefore characterized in the DAS-II handbook (Elliott, 2007b) as requiring integrated analysis and complex transformation of *both* visual and verbal information. Problems in this type of processing may be at the root of John's problems in learning to read.

The diagnostic clusters of Working Memory and Processing Speed offer further information. John's Working Memory score is not significantly lower than his GCA score. However, this con-

TABLE 13.8. WIAT-II and DAS-II Subtest and Cluster Scores for John (Age 7:11)

Subtest or cluster	Score[a]
WIAT-II	
Reading	69
Word Reading	58
Pseudoword Decoding	86
Reading Comprehension	72
Written Language	83
Spelling	79
Written Expression	90
Mathematics	100
DAS-II core clusters (School-Age battery)[b]	
Verbal	102
Nonverbal Reasoning[c]	89
Spatial	102
{GCA	97}
DAS-II diagnostic clusters and subtests	
Working Memory	93
Recall of Sequential Order	$T = 40$
Recall of Digits—Backward	$T = 52$
Processing Speed	89
Speed of Information Processing	$T = 51$
Rapid Naming	$T = 38$
Additional DAS-II diagnostic subtests	
Recall of Objects—Immediate	$T = 40$
Recall of Objects—Delayed	$T = 41$
Recall of Digits—Forward	$T = 53$
Recognition of Pictures	$T = 54$
Phonological Processing	$T = 51$

[a]Standard scores except where indicated.
[b]There are no significant differences between subtests within each cluster.
[c]The Nonverbal Reasoning cluster is significantly lower than *both* the Verbal and Spatial clusters.

clusion is qualified by a significant difference between the two component subtest scores. Recall of Digits—Backward is a purely verbal subtest, and John's score on this is average for his age. On the other hand, his score on Recall of Sequential Order is 12 *T*-score points below his Recall of Digits—Backward score. This difference is highly significant ($p < .01$). Recall of Sequential Order is verbally presented, but requires the examinee to visualize the position of various parts of the body.

Based on the results from the Nonverbal Reasoning cluster, and supported by the results from the Working Memory subtests, it appears that John's processing difficulties do not appear to be shown when he is working with purely auditory–verbal or purely visual–spatial information. Our revised hypothesis is that he seems to have particular difficulties in processing auditory–visual information.

Such a view is confirmed by his scores on the Processing Speed cluster. Once again, his overall cluster score of 89 is not significantly lower than his GCA score. However, his score on the Rapid Naming subtest is 13 *T*-score points lower than his score on Speed of Information Processing, a statistically significant difference ($p < .05$). Rapid Naming presents colors and pictures that have to be named quickly, and this is another example of a subtest that requires auditory–visual processing.

The diagnostic subtest Recall of Objects is another visual–verbal task that yields separate scores for Immediate recall and Delayed recall. The subtest presents a visual array of pictures, which are then removed from view. The student is asked to recall them verbally. John's scores on Recall of Objects are below average, and significantly below the average level of the core subtests ($p < .05$). The other diagnostic subtests, on which John achieved average scores for his age, required either purely verbal or purely visual processing.

As a result of these analyses, there is now strong support for the hypothesis that John's cognitive processing difficulties center on problems with auditory–visual materials. His reading scores support this hypothesis. Reading requires a high level of visual–verbal integration in order to convert visual printed codes into sounds and words. For fluent reading, and for recognition of common words or letter strings, an individual needs information in the auditory–verbal and visual processing systems to be effectively integrated. Similarly, to perform well on the DAS-II Nonverbal Reasoning tasks (or indeed any good measures of fluid reasoning), and on the Recall of Sequential Order, Rapid Naming, and Recall of Objects subtests, one needs good integration of the visual and verbal processing systems. These tasks, like the task of reading, present visual information—but to solve the problems effectively, the use of internal language to label and to mediate the solution of the problems is generally essential. In the case of an individual who has excellent verbal and spatial abilities, if the two brain processing systems specialized for those abilities do not "talk" to each other effectively, this may have an adverse effect on performance both in reasoning and in reading acquisition.

The question now arises about appropriate intervention methods for students who have a consistent pattern of difficulties with tasks requiring auditory–visual integration. For many years, teachers of children with dyslexia have actively advocated multisensory teaching methods, despite research evidence that appeared to discredit auditory–visual integration as a cause of poor reading acquisition (e.g., Bryant, 1968). Teachers appear to have long held the view that children with dyslexia have difficulty integrating visual and verbal information. Thus it has been recommended that multisensory teaching methods should be used as much as possible in teaching John basic literacy skills. Useful references to multisensory teaching approaches are given by Thomson and Watkins (1998), Augur and Briggs (1992), Walker and Brooks (1993), Birsh (1999), and Walker (2000).

CONCLUSIONS

This chapter has outlined various ways in which the DAS-II has been designed to be appealing and accessible to children of all abilities across a very wide age range, from 2:6 to 17:11. Its good floors, and its procedures to help the least able examinees understand what is required in each task, makes the battery highly appropriate for use with clinically referred populations. It has also been designed for speed and efficiency in administration. Its cluster and subtest scores have essential qualities of reliability and interpretability. Its consistency and clarity in measuring the constructs of CHC theory make it an ideal instrument for cross-battery assessment (Flanagan, Ortiz, & Alfonso, 2007). When the DAS was first published in 1990, it was at first virtually unknown and seemed so different in its procedures that professionals probably feared it was difficult to learn. Now in its second edition, it is widely used, and is accepted as an instrument that enjoyably engages children and helps to identify their processing strengths and weaknesses with efficiency and precision.

NOTE

1. This case was kindly provided by Dr. Gloria Maccow, The Psychological Corporation, Pearson Assessments.

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