CHAPTER 22

Use of Ability Tests in the Identification of Specific Learning Disabilities within the Context of an Operational Definition

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There are no rules for converting concepts to operational definitions. Therefore, operational definitions are judged by *significance* (i.e., is it an authoritative marker of the concept?) and *meaningfulness* (i.e., is it a rational and logical marker of the concept?).

—KAVALE, SPAULDING, AND BEAM (2009, p. 41)

Historically, identification of specific learning disabilities (SLD) has almost always included a consideration of an individual's overall cognitive ability, as well as his or her unique pattern of strengths and weaknesses (Sotelo-Dynega, Flanagan, & Alfonso, 2018). However, in recent years intelligence tests and tests of specific cognitive abilities and neuropsychological processes have come under harsh attack as useful tools in the identification of SLD (for a review, see Schneider & Kaufman, 2017). Although "IQ" tests have always had their critics, it was not until the reauthorization of the Individuals with Disabilities Education Improvement Act (IDEA, 2004) and the publication of its attendant regulations (U.S. Department of Education, 2006) that such criticism became more widespread (Fletcher-Janzen & Reynolds, 2008).

It is beyond the scope of this chapter to review all the issues surrounding the debate about the utility (or lack thereof) of cognitive and neuropsychological tests in the identification of SLD. The interested reader is referred to Alfonso and Flanagan (2018) for a comprehensive treatment of these issues. Based on our review of the literature and our clinical experience, we find inherent utility in cognitive and neuropsychological assessment for SLD identification and treatment. Therefore, the purposes of this chapter are to describe Flanagan, Ortiz, and Alfonso's (2013, 2017) operational definition of SLD, and to highlight the importance and utility of gathering data from cognitive and neuropsychological tests (among other quantitative and qualitative data sources) within this framework (see also Flanagan, Alfonso, Sy, et al., 2018).

This chapter was adapted from Flanagan, Alfonso, Sy, Mascolo, McDonough, and Ortiz (2018).

A BRIEF PERSPECTIVE ON THE DEFINITION OF SLD

IDEA 2004 defines *SLD* as "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. Such terms include such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia," and SLD "does not include learning problems that are primarily the result of visual, hearing, or motor disabilities; of intellectual disability; of emotional disturbance; or of environmental, cultural, or economic disadvantage." Many researchers in the field (e.g., Kavale, Spaulding, & Beam, 2009) have argued that the federal definition of SLD in IDEA 2004 and its regulations do not reflect the best thinking about the SLD construct because it has not changed in well over 30 years. This fact is astonishing, as several decades of inquiry into the nature of SLD resulted in numerous (but unsuccessful) proposals over the years to modify the definition. If the field of SLD is to recapture its status as a reliable entity in special education and psychology, then more attention must be paid to the federal definition (Kavale & Forness, 2000). To bring clarity to the definition, Kavale and colleagues (2009) specified the boundaries of the term and the class of things to which it belongs. In addition, their definition delineates what SLD is and what it is not. Although their description is not a radical departure from the federal definition, it provides a more comprehensive description of the nature of SLD. The Kavale and colleagues definition is as follows:

> Specific learning disability refers to heterogeneous clusters of disorders that significantly impede the normal progress of academic achievement . . . The lack of progress is exhibited in school performance that remains below expectation for chronological and mental ages, even when [the student is] provided with high-quality instruction. The primary manifestation of the failure to progress is significant underachievement in a basic skill area (i.e., reading, math, writing) that is not associated with insufficient educational, cultural/familial, and/or sociolinguistic experiences. The primary severe ability–achievement discrepancy is coincident with deficits in linguistic competence (receptive and/or expressive), cognitive functioning (e.g., problem solving, thinking abilities, maturation), neuropsychological processes (e.g., perception, attention, memory), or any combination of such contributing deficits that are presumed to originate from central nervous system dysfunction. The specific learning disability is a discrete condition differentiated from generalized learning failure by average or above (>90) cognitive ability and a learning skill profile exhibiting significant scatter indicating areas of strength and weakness. The major specific learning disability may be accompanied by secondary learning difficulties that also may be considered when [educators are] planning the more intensive, individualized special education instruction directed at the primary problem. (p. 46)

Kavale and colleagues state that their richer description of SLD "can be readily translated into an operational definition providing more confidence in the validity of a diagnosis of SLD" (p. 46). In the following section, we describe an operational definition of SLD that captures the nature of SLD as reflected in the federal definition and in Kavale and colleagues' definition. In addition, the reasons why operational definitions are important and necessary for SLD identification are highlighted.

THE NEED FOR AN OPERATIONAL DEFINITION OF SLD

An operational definition of SLD is needed to provide more confidence in the validity of the SLD diagnosis (Flanagan, Fiorello, & Ortiz, 2010; Flanagan & Schneider, 2016; Kavale et al., 2009). An *operational definition* provides a process for the identification and classification of concepts that have been defined formally (see Sotelo-Dynega, Flanagan, & Alfonso, 2018, for a summary). With no change in the federal definition of SLD, the field has turned to articulating ways to operationalize SLD, with the intent of improving the clinical identification of this condition (Alfonso & Flanagan, 2018; Flanagan et al., 2013; Flanagan, Ortiz, Alfonso, & Mascolo, 2002, 2006; Kavale & Flanagan, 2007; Kavale & Forness, 2000; Kavale et al., 2009; Schneider & Kaufman, 2017; Swanson, 1991).

For more than three decades, the main operational definition of SLD was the so-called "discrepancy criterion." Discrepancy was first introduced in Bateman's (1965) definition of learning disabilities (LD) and later was formalized in federal regulations as follows:

> (1) The child does not achieve commensurate with his or her age and ability when provided with appropriate educational experiences, and (2) the child has

> a *severe discrepancy between achievement and intellectual ability* in one or more areas relating to communication skills and mathematics abilities. (U.S. Office of Education, 1977, p. 65083; emphasis added)

Several problems with the traditional ability–achievement discrepancy approach to SLD identification have been discussed extensively in the literature and are highlighted elsewhere (e.g., Hale, Wycoff, & Fiorello, 2011; see also Fiorello & Wycoff, Chapter 26, this volume); therefore, they are not repeated here.

With the reauthorization of IDEA in 2004, and the corresponding deemphasis on the traditional ability–achievement discrepancy criterion for SLD identification, there have been several attempts to operationalize the federal definition, many of which can be found in Alfonso and Flanagan (2018). Table 22.1 provides examples of how the 2004 federal definition of SLD has been operationalized.

One of the most comprehensive operational definitions of SLD was described nearly 20 years ago by Kavale and Forness (2000). These researchers critically reviewed the available definitions of learning disability and methods for their operationalization, and found them to be largely inadequate. Therefore, they proposed a modest, hierarchical operational definition that reflected current research (at the time) on the nature of SLD. Their operational definition is illustrated in Figure 22.1.

In their definition, Kavale and Forness (2000) attempted to incorporate the complex and multivariate nature of SLD. Figure 22.1 shows that SLD is determined through evaluation of performance at several "levels," each of which specifies particular diagnostic conditions. Furthermore, each level of the evaluation hierarchy depicted in Figure 22.1 represents a necessary, but not sufficient, condition for SLD determination. Kavale and Forness contended that it is only when the specified criteria are met at all five levels of their operational definition that SLD can be established as a "discrete and independent condition" (p. 251). Through their operational definition, Kavale and Forness provided a much more rational and defensible approach to the practice of SLD identification than that which had been offered previously. In short, their operationalization of SLD used "foundation principles in guiding the selection of elements that explicate the nature of LD" (p. 251); this represented both a departure from and an important new direction for current practice.

Flanagan and colleagues (2002) identified some aspects of Kavale and Forness's (2000) operational definition that they believed needed to be modified. For example, although Kavale and Forness's operational definition captured the complex and multivariate nature of SLD, it was not predicated on any particular theoretical model, and it did not specify what methods might be used to satisfy criteria at each level. In addition, the hierarchical structure depicted in Figure 22.1 seems to imply somewhat of a linear approach to SLD identification, whereas the process is typically more recursive and iterative. Consequently, Flanagan and colleagues proposed a similar operational definition of SLD, but based their definition primarily on the Cattell–Horn–Carroll (CHC) theory and its research base. In addition, these researchers provided greater specification of methods and criteria that may be used to identify SLD (e.g., Flanagan et al., 2013).

Because operational definitions represent only temporary assumptions about a concept, they are subject to change (Kavale et al., 2009). Flanagan and colleagues modify their operational definition routinely to ensure that it reflects the most current theory, research, and thinking with regard to (1) the nature of SLD; (2) the methods of evaluating various elements and concepts inherent in SLD definitions (viz., the federal definition); and

TABLE 22.1. Examples of How the IDEA 2004 Federal Definition of SLD Has Been Operationally Defined

- Absolute low achievement (for a discussion, see Burns, Maki, Warmbold-Brann, & Preast, 2018; Fletcher & Miciak, 2018; Lichtenstein & Klotz, 2007)
- Ability–achievement discrepancy (see Zirkel & Thomas, 2010, for a discussion)
- Failure to respond to scientifically based intervention (see Balu et al., 2015; Fletcher, Barth, & Stuebing, 2011; Fletcher, Lyon, Fuchs, & Barnes, 2007; Fletcher & Miciak, 2018; Fuchs & Fuchs, 1998; Hosp, Hosp, & Howell, 2007)
- Pattern of strengths and weaknesses (PSW; also called *alternative research-based approach* or *third-method* approach) (see Flanagan, Ortiz, & Alfonso, 2013, 2017; Hale, Flanagan, & Naglieri, 2008; Hale, Wycoff, & Fiorello, 2011; see also Alfonso & Flanagan, 2018, for a review of prominent PSW methods)

Note. All examples in this table include a consideration of exclusionary factors as specified in the federal definition of SLD.

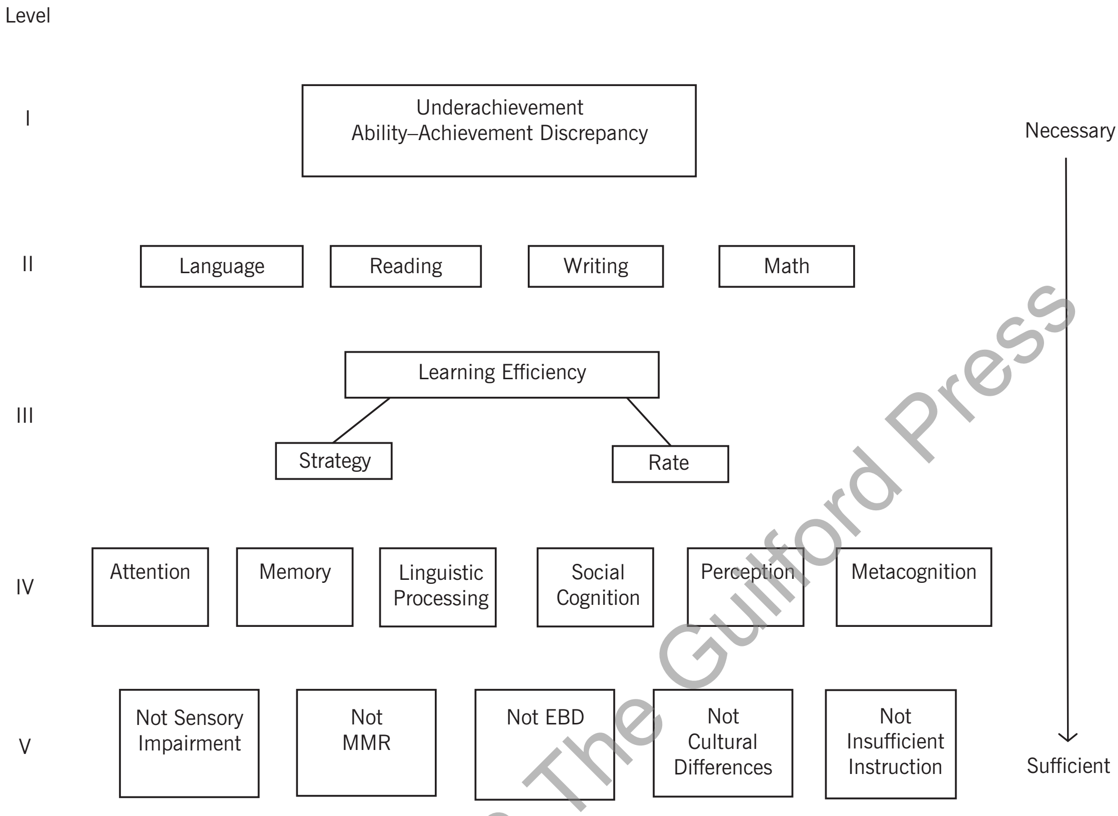

FIGURE 22.1. Kavale and Forness's operational definition of SLD. MMR, mild mental retardation (now called mild intellectual disability); EBD, emotional or behavioral disorder. From Kavale and Forness (2000). Copyright © by SAGE Publications, Inc. Reprinted by permission of SAGE Publications, Inc.

(3) criteria for establishing SLD as a discrete condition separate from undifferentiated low achievement and overall below-average ability to think and reason, particularly for the purpose of acquiring, developing, and applying academic skills (Flanagan et al., 2017; Flanagan, Alfonso, Sy, et al., 2018). Their operational definition of SLD is now referred to as the *dual-discrepancy/consistency* (DD/C) method (Flanagan et al., 2013, 2017; Flanagan, Alfonso, Sy, et al., 2018) and is presented in Figure 22.2. Flanagan and colleagues' approach to SLD identification encourages a continuum of data-gathering methods, beginning with curriculum-based measurement (CBM) and progress monitoring, and culminating in norm-referenced tests of cognitive abilities and neuropsychological processes for students who demonstrate an inadequate response to intervention.

Figure 22.2 shows that the DD/C operational definition of SLD is arranged according to levels, as is Kavale and Forness's (2000) definition. At each level, the definition includes (1) defining characteristics regarding the nature of SLD (e.g., an individual has difficulties in one or more areas of academic achievement); (2) the focus of evaluation for each characteristic (e.g., academic achievement, cognitive abilities/neuropsychological processes, exclusionary factors); (3) examples of evaluation methods and relevant data sources (e.g., standardized, norm-referenced tests and educational records, respectively); and (4) the criteria that need to be met to establish that an individual possesses a particular characteristic of SLD (e.g., below-average performance in an academic area, such as basic reading skill; cognitive processing weaknesses that are related to the academic skill weaknesses). As may be seen in Figure 22.2, the "Nature of SLD" column includes a description of what SLD is and what it is not. Overall, the levels represent adaptations and extensions of the recommendations offered by Kavale and colleagues (e.g., Kavale & For-

Level	Nature of SLD[a]	Focus of Evaluation	Examples of Evaluation Methods and Data Sources	Criteria for SLD	SLD Classification and Eligibility
I	Difficulties in one or more areas of academic achievement, including (but not limited to)[b] basic reading skill, reading comprehension, reading fluency, oral expression, listening comprehension, written expression, math calculation, and math problem solving.	**Academic Achievement:** Performance in specific academic skills (e.g., Grw [reading decoding, reading fluency, reading comprehension, spelling, written expression], Gq [math calculation, math problem solving], and Gc [communication ability, listening ability]).	Response to high-quality instruction and intervention via progress monitoring; performance on norm-referenced; standardized achievement tests; evaluation of work samples; observations of academic performance; teacher/parent/student interview; history of academic performance; and data from other members of the multidisciplinary team (MDT) (e.g., speech–language pathologist, interventionist, reading specialist).	Performance in one or more academic areas is *weak or deficient*[c] (despite attempts at delivering higher-quality instruction) as evidenced by converging data sources. Note that low scores are not sufficient to meet this condition. These scores must also represent *unexpected underachievement* (a condition determined by X-BASS, based on an individual's unique pattern of scores).	**Necessary**
II	SLD does not include a learning problem that is the result of visual, hearing, or motor disabilities; of intellectual disability; of social or emotional difficulty or disorder; or of environmental, educational, cultural, or economic disadvantage.	**Exclusionary Factors:** Identification of potential primary causes of academic skill weaknesses or deficits, including intellectual disability, cultural or linguistic difference, sensory impairment, insufficient instruction or opportunity to learn, organic or physical health factors, social-emotional or psychological difficulty or disorder.	Data from the methods and sources listed at levels I and III; behavior rating scales; medical records; prior evaluations; interviews with current or past professionals (counselors, psychiatrists, etc.)	Performance is not *primarily* attributed to these exclusionary factors, although one or more of them may contribute to learning difficulties. (Consider using the Exclusionary Factors form, which is included in this chapter as Figure 22.3.)	
III	A disorder in one or more of the basic psychological/neuropsychological processes involved in understanding or in using language, spoken or written; such disorders are presumed to originate from central nervous system dysfunction.	**Cognitive Abilities and Processes:** Performance in cognitive abilities and processes (e.g., Gv, Ga, Glr, Gsm, Gs), specific neuropsychological processes (e.g., attention, executive functioning, orthographic processing, rapid automatic naming), and learning efficiency (e.g., associative memory, free-recall memory, meaningful memory).	Performance on norm-referenced tests; evaluation of work samples; observations of cognitive performance; task analysis; testing limits; teacher/parent/student interview; history of academic performance; and records review.	Performance in one or more cognitive abilities and/or neuropsychological processes (related to academic skill deficiency) is *weak or deficient*[c] as evidenced by converging data sources. Note that low scores are not sufficient to meet this condition. The cognitive ability or process in question must also be *domain-specific* (a condition determined	

				by X-BASS, based on an individual's unique pattern of scores).	
IV	The SLD is a discrete condition differentiated from generalized learning deficiency by generally average or better ability to think and reason and a learning skill profile exhibiting significant variability, indicating a pattern of cognitive and academic strengths and weaknesses.	**Pattern of Strengths and Weaknesses (PSW) Marked by a Dual-Discrepancy/Consistency (DD/C) Situation:** Determination of whether academic skill weaknesses or deficits are *unexpected* and related to *domain-specific* cognitive weaknesses or deficits; pattern of data reflects a below-average aptitude–achievement *consistency* with at least *average ability* to think and reason.	Data gathered at all previous levels, as well as any additional data following a review of initial evaluation results (e.g., data gathered for hypothesis testing; data gathered via demand analysis and limits testing).	Circumscribed below-average aptitude–achievement *consistency*; circumscribed ability–achievement and ability–cognitive aptitude *discrepancies*, with at least average ability to think and reason; clinical judgment supports the impression that the student's overall ability to think and reason will enable him or her to benefit from tailored or specialized instruction/intervention, compensatory strategies, and accommodations, such that his or her performance rate and level will likely approximate those of more typically achieving, nondisabled peers. The DD/C PSW analysis is conducted by X-BASS, based on an individual's unique pattern of strengths and weaknesses.	↓ **Sufficient for SLD Identification**
V	The SLD has an adverse impact on educational performance.	**Special Education Eligibility:**[d] Determination of least restrictive environment (LRE) for delivery of instruction and educational resources.	Data from all previous levels and MDT meetings.	Student demonstrates significant difficulties in daily academic activities that cannot be remediated, accommodated, or otherwise compensated for *without* the assistance of individualized special education services.	**Necessary for Special Education Eligibility**

[1]This column includes concepts inherent in the federal definition (IDEA, 2004), Kavale, Spaulding, and Beam's (2009) definition, Harrison and Holmes's (2012) consensus definition, and other prominent definitions of SLD (see Sotelo-Dynega, 2018). Thus, he most salient prominent SLD markers are included in this column.

[2]Poor spelling with adequate ability to express ideas in writing is often typical of dyslexia and/or dysgraphia. Even though IDEA 2004 includes only the broad category of written expression, poor spelling and handwriting are often symptomatic of a specific writing disability and should not be ignored (Wendling & Mather, 2009).

[3]Weak performance is typically associated with standard scores in the 85–89 range, whereas deficient performance is often associated with standard scores that are greater than 1 *SD* below the mean. Interpretations of weak or deficient performance based on standard scores that fall in the weak and deficient ranges are bolstered when they have ecological validity (e.g., when there is evidence that the abilities or processes identified as weak or deficient manifest in everyday classroom activities that require these abilities and processes).

[4]The major SLD may be accompanied by secondary learning difficulties that should be considered in planning the more intensive, individualized special education instruction directed at the primary problem. For information on linking assessment data to intervention, see Mascolo, Alfonso, and Flanagan (2014).

FIGURE 22.2. A CHC-based operational definition of SLD; this approach is now known as the DD/C method. X-BASS, Cross-Battery Assessment Software System (Flanagan, Ortiz, & Alfonso, 2017). Based on Flanagan and Alfonso (2017) and Flanagan, Ortiz, and Alfonso (2013).

ness, 2000; Kavale et al., 2009), but they also include concepts from various other researchers (e.g., Berninger, 2011; Decker, Bridges, & Vetter, 2018; Fletcher-Janzen & Reynolds, 2008; Geary, Hoard, & Bailey, 2011; Geary et al., 2017; Hale & Fiorello, 2004; Hale et al., 2010; Mazzocco & Vukovic, 2018; Nelson & Wiig, 2018; Reynolds & Shaywitz, 2009a, 2009b; Siegel, 1999; Stanovich, 1999; Vellutino, Scanlon, & Lyon, 2000).

The DD/C operational definition of SLD presented in Figure 22.2 differs from the one presented by Kavale and Forness (2000; see Figure 22.1) in four important ways. First, it is grounded in a well-validated contemporary theory on the structure of abilities (i.e., CHC theory; see Schneider & McGrew, Chapter 3, this volume, for a description). Second, in lieu of the traditional ability–achievement discrepancy method, a specific pattern of cognitive and academic ability and neuropsychological processing strengths and weaknesses is used as a defining characteristic or marker for SLD.[1] (It is important to understand that any pattern used for SLD determination should be supported by research on the relations among CHC abilities, processes, and academic outcomes—and, where possible, evidence on the neurobiological correlates of learning disorders in reading, math, and writing; see McDonough, Flanagan, Sy, & Alfonso, 2017.) Third, the evaluation of exclusionary factors occurs earlier in the SLD identification process in our operational definition, to prevent individuals from having to undergo additional testing. Fourth, we emphasize that SLD assessment is a recursive process rather than a linear one, and that information generated and evaluated at one level may inform decisions made at other levels. The recursive nature of the SLD identification process is reflected by the circular arrows in Figure 22.2. Each level of the CHC-based operational definition of SLD is described in more detail in the next section.

THE DD/C OPERATIONAL DEFINITION OF SLD

> A diagnosis identifies the nature of a specific learning disability and has implications for its probable etiology, instructional requirements, and prognosis. Ironically, in an era when educational practitioners are encouraged to use evidence-based instructional practices, they are not encouraged to use evidence-based differential diagnoses of specific learning disabilities.
>
> —Berninger (2011, p. 204)

According to the U.S. Department of Education (2006) regulations, there are three permissible methods for the identification of SLD: (1) traditional ability–achievement discrepancy, (2) response to intervention, and (3) alternative research-based approaches. The DD/C operational definition of SLD is consistent with the alternative research-based "third option" for SLD identification. The DD/C definition is grounded primarily in CHC theory, but has been extended to include important neuropsychological functions that are not explicit in CHC theory (e.g., executive functions, orthographic processing, cognitive efficiency). The essential elements in evaluation of SLD in the DD/C definition include (1) academic ability analysis, (2) evaluation of mitigating and exclusionary factors, (3) cognitive ability and processing analysis, (4) pattern of strengths and weaknesses (PSW) analysis, and (5) evaluation of interference with learning for purposes of special education eligibility.

It is assumed that the levels of evaluation depicted in Figure 22.2 are undertaken after it has been determined that the student is demonstrating an inadequate response to high-quality instruction and pre-referral interventions (consistent with tiers 1 and 2 of a response-to-intervention [RTI] approach or a multi-tiered system of support [MTSS]) have been conducted with little or no success, and therefore a focused evaluation of specific abilities and processes through standardized testing of cognitive and academic abilities is deemed necessary (Flanagan, Fiorello, et al., 2010; see also McCloskey, Slonim, & Rumohr, Chapter 39, this volume). Evaluation for the presence of an SLD assumes that an individual has been referred for testing specifically because of observed learning difficulties. Moreover, before a formal SLD assessment is begun, other data from multiple sources may have (and probably should have) already been uncovered within the context of intervention implementation. These data may include results from CBM, progress monitoring, informal testing, direct observation of behaviors, work samples, reports from people familiar with the child's difficulties (e.g., teachers, parents), and information provided by the child him- or herself. This type of systematic approach to understanding learning difficulties can emanate from any well-researched theory (e.g., Decker et al., 2018; Hale, Wycoff, & Fiorello, 2011; McCloskey, Whitaker, Murphy, & Rogers, 2012; McDonough & Flanagan, 2016). A summary of each level of the DD/C operational definition of SLD follows.

Level I: Difficulties in One or More Areas of Academic Achievement

SLD is marked by dysfunction in learning. That is, learning is somehow disrupted from its normal course by an underlying ability and processing deficits. Although the specific mechanism that inhibits learning is not directly observable, one can proceed on the assumption that it manifests in observable phenomena, particularly academic achievement. Thus level I of the operational definition involves documenting that some type of *learning* deficit exists. In the DD/C definition, the presence of a *weakness* or *normative weakness/deficit* (Table 22.2) —established through standardized testing of the major areas of academic achievement (e.g., reading, writing, math, oral language), and supported through other means, such as clinical observations of academic performance, work samples, and parent and teacher reports—is a necessary but insufficient condition for SLD determination. A finding of a weakness in academic achievement is not sufficient for SLD identification because this condition alone may be present for a variety of reasons, only one of which is SLD. Furthermore, the academic area of weakness must also meet criteria for *unexpected underachievement*, as discussed later in this chapter.

The academic areas that are generally assessed at level I in the DD/C operational definition include the eight areas of achievement specified in the federal definition of SLD (IDEA, 2004). These eight areas are basic reading skills, reading fluency, reading comprehension, math calculation, math problem solving, written expression, listening comprehension, and oral expression. Most of the skills and abilities measured at level I represent an individual's stores of acquired knowledge. These specific knowledge bases (e.g., quantitative knowledge [Gq], reading and writing ability [Grw], vocabulary knowledge [Gc]) develop largely as a function of formal instruction, schooling, and educationally related experiences (Carroll, 1993). Typically, the eight areas of academic achievement are measured via standardized, norm-referenced tests. In fact, many comprehensive achievement batteries, such as the Wechsler Individual Achievement Test—Third Edition (WIAT-III; Pearson, 2009), the Woodcock–Johnson IV Tests of Achievement (Schrank, Mather, & McGrew, 2014), and the Kaufman Test of Educational Achievement, Third Edition (KTEA-3; Kaufman & Kaufman, 2014), measure all eight areas (see Table 22.3). It is important to realize that data on academic performance should come from multiple sources (see Figure 22.2, level I, column 4).

If weaknesses or deficits in the child's academic achievement profile are not identified, then the issue of SLD may be moot because such weakness-

TABLE 22.2. Definition of Weakness and Normative Weakness or Deficit

Term or concept	Meaning within the context of DD/C	Comments
Weakness	Performance on standardized, norm-referenced tests that falls *below average* (where average is defined as standard scores between 90 and 110 [inclusive], based on a scale having a mean of 100 and standard deviation of 15). Thus a weakness is associated with standard scores of 85 to 89 (inclusive).	Interpreting scores in the very narrow range of 85–89 requires clinical judgment, as abilities associated with these scores may or may not pose significant difficulties for an individual. Interpretation of any cognitive construct as a weakness for the individual should include ecological validity (i.e., evidence of how the weakness manifests itself in real-world performances, such as classroom activities).
Normative weakness or deficit	Performance on standardized, norm-referenced tests that falls greater than one standard deviation below the mean (i.e., standard scores <85). This type of weakness is often referred to as *population-relative* or *interindividual.* The terms *normative weakness* and *deficit* are used interchangeably.	The range of 85–115, inclusive, is often referred to as the range of *normal limits* because it is the range in which nearly 70% of the population falls on standardized, norm-referenced tests. Therefore, scores within this range are sometimes classified as *within normal limits* (WNL). As such, any score that falls outside and below this range is a normative weakness *as compared to most people*. Notwithstanding, the meaning of any cognitive construct that emerges as a normative weakness is enhanced by ecological validity.

TABLE 22.3. Correspondence between Eight Areas of SLD and WIAT-III, WJ IV Tests of Achievement, and KTEA-3 Subtests

Areas in which SLD may be manifested (listed in IDEA 2004)	WIAT-III subtests	WJ IV subtests	KTEA-3 subtests
Oral expression	Oral Expression		Association Fluency Object Naming Facility Oral Expression
Listening comprehension	Listening Comprehension		Listening Comprehension
Written expression	Alphabet Writing Fluency Sentence Composition Essay Composition Spelling	Spelling Writing Samples Sentence Writing Fluency Editing	Spelling Written Expression
Basic reading skills	Early Reading Skills Word Reading Pseudoword Decoding	Letter–Word Identification Word Attack	Decoding Fluency Letter and Word Recognition Nonsense Word Decoding Phonological Processing
Reading fluency skills	Oral Reading Fluency	Sentence Reading Fluency Oral Reading Word Reading Fluency	Silent Reading Fluency Word Recognition Fluency
Reading comprehension	Reading Comprehension	Passage Comprehension Reading Recall Reading Vocabulary	Reading Comprehension Reading Vocabulary
Mathematics calculation	Numerical Operations Math Fluency—Addition Math Fluency—Subtraction Math Fluency—Multiplication	Calculation Math Facts Fluency	Math Computation Math Fluency
Mathematics problem solving	Math Problem Solving	Applied Problems Number Matrices	Math Concepts and Applications

es are a necessary component of the definition. Nevertheless, some children who struggle academically may not demonstrate academic weaknesses or deficits on standardized, norm-referenced tests of achievement; this is particularly true of very bright students, for a variety of reasons. For example, some children may have figured out how to compensate for their processing deficits. Therefore, it is important not to assume that a child with a standard score in the upper 80s or low 90s on a "broad reading" composite is "OK," particularly when a parent, a teacher, or the student him- or herself expresses concern. Under these circumstances, a more focused assessment of the CHC and neuropsychological processes related to reading should be conducted. Conversely, the finding of low scores on norm-referenced achievement tests does not guarantee that there will be corresponding low scores on norm-referenced cognitive tests in areas that are related to the achievement area—*an important fact that was ignored in a relatively recent investigation of the DD/C method* (i.e., Kranzler, Floyd, Benson, Zaboski, & Thibodaux, 2016b). Below-average achievement may be the result of a host of factors, only one of which is weaknesses or deficits in related cognitive processes and abilities. Most practitioners know this to be true. See Flanagan and Schneider (2016) for a discussion. When weaknesses or deficits in academic performance are found, and are corroborated by other data sources, the process advances to level II.

Level II: Exclusionary Factors as Potential Primary or Contributory Reasons

Level II involves evaluating whether any documented weaknesses or deficits found through level I evaluation are or are not *primarily* the result of factors that may be, for example, largely external to the child, noncognitive in nature, or the result of a disorder other than SLD. Because there can be many reasons for weak or deficient academic performance, causal links to SLD should not be ascribed prematurely. Instead, reasonable hypotheses related to other potential causes for academic weaknesses should be developed. For example, cultural and linguistic differences are two common factors that can affect both test performance and academic skill acquisition adversely and can result in achievement data that appear to suggest SLD (see Ortiz, Melo, & Terzulli, 2018; Ortiz, Piazza, Ochoa, & Dynda, Chapter 25, this volume). In addition, lack of motivation, social-emotional disturbance, performance anxiety, psychiatric disorders, sensory impairments, and medical conditions (e.g., hearing or vision problems) also need to be ruled out as potential explanatory correlates to (or *primary* reasons for) any weaknesses or deficits identified at level I. Figure 22.3 provides an example of a form that may be used to document systematically and thoroughly that the exclusionary factors listed in the federal definition of SLD were evaluated.

Note that because the process of SLD determination does not necessarily occur in a strict linear fashion, evaluations at levels I and II often take place concurrently, as data from level II are often necessary to understand performance at level I. The circular arrows between levels I and II in Figure 22.2 are meant to illustrate the fact that interpretations and decisions that are based on data gathered at level I may need to be informed by data gathered at level II. Ultimately, at level II, the practitioner must judge the extent to which any factors other than cognitive impairment can be considered the *primary* reason for the academic performance difficulties. The form in Figure 22.3 provides space for documenting this judgment. If performance cannot be attributed primarily to other factors, then the second criterion necessary for establishing SLD according to the operational definition is met, and assessment may continue to the next level.

It is important to recognize that although factors such as having English as a second language may be present and may affect performance adversely, SLD can also be present. Certainly, children who have vision problems, chronic illnesses, limited English proficiency, and so forth, may also have SLD. Therefore, when these or other factors at level II are present, or even when they are determined to be *contributing* to poor performance, SLD should not be ruled out. Rather, only when such factors are determined to be *primarily* responsible for weaknesses in learning and academic performance—not merely contributing to them—should SLD be discounted as an explanation for dysfunction in academic performance. Examination of exclusionary factors is necessary to ensure fair and equitable interpretation of the data collected for SLD determination and, as such, is not intended to *rule in* SLD. Rather, careful examination of exclusionary factors is intended to rule out other possible explanations for deficient academic performance.

One of the major reasons for placing evaluation of exclusionary factors at this (early) point in the SLD assessment process is to provide a mechanism that is efficient in both time and effort, and that may prevent the unnecessary administration of additional tests. However, it may not be possible to rule out all the numerous potential exclusionary factors completely and convincingly at this stage in the assessment process. For example, the data gathered at levels I and II may be insufficient to draw conclusions about such conditions as developmental disabilities and intellectual disability (ID; see Farmer & Floyd, Chapter 23, this volume), which often requires more thorough and direct assessment (e.g., administration of an intelligence test and adaptive behavior scale). When exclusionary factors—at least those that can be evaluated at this level—have been examined carefully and eliminated as possible *primary* explanations for poor academic performance, the process may advance to the next level.

Level III: Performance in Cognitive Abilities and Neuropsychological Processes

The criterion at level III is like the one specified in level I, except that it is evaluated with data from an assessment of cognitive abilities and neuropsychological processes. Analysis of data generated from the administration of standardized tests represents the most common method available by which cognitive abilities and neuropsychological processes in children are evaluated. However, other types of information and data are relevant to

Evaluation and Consideration of Exclusionary Factors for SLD Identification

An evaluation for specific learning disabilities (SLD) requires an evaluation and consideration of factors *other* than a disorder in one or more basic psychological processes that may be the primary cause of a student's academic skill weaknesses and learning difficulties. These factors include (but are not limited to) vision/hearing[a] or motor disabilities, intellectual disability (ID), social-emotional or psychological disturbance, environmental or economic disadvantage, cultural and linguistic factors (e.g., limited English proficiency), insufficient instruction or opportunity to learn, and physical/health factors. These factors may be evaluated via behavior rating scales, parent and teacher interviews, classroom observations, attendance records, social/developmental history, family history, vision/hearing exams, medical records, prior evaluations, and interviews with current or past counselors, psychiatrists, and paraprofessionals who have worked with the student. Noteworthy is the fact that students with (and without) SLD often have one or more factors (listed below) that *contribute* to academic and learning difficulties. However, the practitioner must rule out any of these factors as being the *primary* reason for a student's academic and learning difficulties to maintain SLD as a viable classification/diagnosis.

Vision (check all that apply):

- ☐ Vision test recent (within 1 year)
- ☐ Vision test outdated (>1 year)
- ☐ Passed
- ☐ Failed
- ☐ Wears glasses
- ☐ History of visual disorder/disturbance
- ☐ Diagnosed visual disorder/disturbance
- ☐ Name of disorder: ______________________________
- ☐ Vision difficulties suspected or observed (e.g., difficulty with far- or near-point copying; misaligned numbers in written math work; squinting or rubbing eyes during visual tasks such as reading, computer use)

Notes: ____
____
____
____
____

Hearing (check all that apply):[b]

- ☐ Hearing test recent (within 1 year)
- ☐ Hearing test outdated (>1 year)
- ☐ Passed
- ☐ Failed
- ☐ Uses hearing aids
- ☐ History of auditory disorder/disturbance
- ☐ Diagnosed auditory disorder/disturbance
- ☐ Name of disorder: ______________________
- ☐ Hearing difficulties suggested in the referral (e.g., frequent requests for repetition of auditory information; misarticulated words; attempts to self-accommodate by moving closer to sound source; obvious attempts to read speech)

Notes: ____
____
____
____
____

(continued)

FIGURE 22.3. Form for documenting evaluation of exclusionary factors in the SLD identification process. Developed by Jennifer T. Mascolo and Dawn P. Flanagan. This form may be reproduced and disseminated.

Motor Functioning (check all that apply):

- ☐ Fine motor delay/difficulty
- ☐ Gross motor delay/difficulty
- ☐ Improper pencil grip (specify type: ______________)
- ☐ Assistive devices/aids used (e.g., weighted pens, pencil grip, slant board)
- ☐ History of motor disorder
- ☐ Diagnosed motor disorder
- ☐ Name of disorder: ______________
- ☐ Motor difficulties suggested in the referral (e.g., illegible writing; issues with letter or number formation, size, spacing; difficulty with fine motor tasks such as using scissors, folding paper)

Notes: ______________

____

Cognitive and Adaptive Functioning (Check All That Apply):

- ☐ Significantly "subaverage intellectual functioning" (e.g., IQ score of 75 or below)
- ☐ Pervasive cognitive deficits (e.g., weaknesses or deficits in many cognitive areas, including Gf *and* Gc)
- ☐ Deficits in adaptive functioning (e.g., social skills, communication, self-care)
- ☐ Areas of significant adaptive skill weaknesses (check all that apply):

☐ Motor skills	☐ Communication	☐ Socialization
☐ Daily living skills	☐ Behavioral/emotional skills	☐ Other

Notes: ______________

____

Social-Emotional/Psychological Factors (check all that apply):

- ☐ Diagnosed psychological disorder (specify: ______________)
- ☐ Date of diagnosis: ______________
- ☐ Family history significant for psychological difficulties
- ☐ Disorder presently treated (specify treatment modality—e.g., counseling, medication): ______________
- ☐ Reported difficulties with social-emotional functioning (e.g., social phobia, anxiety, depression)
- ☐ Social-emotional/psychological issues suspected or suggested by referral
- ☐ Home–school adjustment difficulties
- ☐ Lack of motivation/effort
- ☐ Emotional stress
- ☐ Autism
- ☐ Present medications (type, dosage, frequency, duration):
- ☐ Prior medication use (type, dosage, frequency, duration):
- ☐ Hospitalization for psychological difficulties (date[s]: ______________)
- ☐ Deficits in social, emotional, or behavioral [SEB] functioning (e.g., as assessed by standardized rating scales) —significant scores from SEB measures:

Notes: ______________

____

(continued)

FIGURE 22.3. *(continued)*

Environmental/Economic Factors (check all that apply):

☐ Limited access to educational materials in the home
☐ Caregivers unable to provide instructional support
☐ Economic considerations precluded treatment of identified issues (e.g., filling a prescription, replacing broken glasses, tutoring)
☐ Temporary crisis situation
☐ History of educational neglect
☐ Frequent transitions (e.g., shared custody)
☐ Environmental space issues (e.g., no space for studying, sleep disruptions due to shared sleeping space)

Notes: ______________________________

Cultural/Linguistic Factors (check all that apply):[c]

☐ Limited number of years in U.S. (________)
☐ No history of early or developmental problems in primary language
☐ Current primary-language proficiency: (Date: ________ Scores: ________)
☐ Acculturative knowledge development (Circle one: High Moderate Low)
☐ Language(s) other than English spoken in home
☐ Lack of or limited instruction in primary language (# of years: ________)
☐ Current English-language proficiency: (Date: ________ Scores: ________)
☐ Parental educational and socioeconomic level (Circle one: High Moderate Low)

Notes: ______________________________

Physical/Health Factors (check all that apply):

☐ Limited access to health care
☐ Minimal documentation of health history/status
☐ Chronic health condition (specify: ______________________________)
☐ Temporary health condition (date/duration: ______________________________)
☐ Hospitalization (dates: ______________________________)
☐ History of Medical Condition (date diagnosed: ______________________________)
☐ Medical treatments (specify: ______________________________)
☐ Repeated visits to doctor/school nurse
☐ Medication (type, dosage, frequency, duration: ______________________________)

Notes: ______________________________

Instructional Factors (check all that apply):

☐ Interrupted schooling (e.g., midyear school move) Specify why: ______________________________
☐ New teacher (past 6 months)
☐ Nontraditional curriculum (e.g., home-schooled)
☐ Days absent/tardy: ____________
☐ Retained or advanced a grade or more
☐ Accelerated curriculum (e.g., AP classes)

Notes: ______________________________

(continued)

FIGURE 22.3. *(continued)*

Determination of Primary and Contributory Causes of Academic Weaknesses and Learning Difficulties (check one):

☐ Based on the available data, it is reasonable to conclude that one or more factors are *primarily* responsible for the student's observed learning difficulties. Specify: ______________________________

☐ Based on the available data, it is reasonable to conclude that one or more factors *contribute* to the student's observed learning difficulties. Specify: ____

☐ *No* factors listed here appear to be the primary cause of the student's academic weaknesses and learning difficulties.

[a]For a vision or hearing disorder, it is important to understand the nature of the disorder, its expected impact on achievement, and the time of diagnosis. It is also important to understand what was happening instructionally at the time the disorder was suspected and/or diagnosed.

With regard to hearing, even mild loss can impact initial receptive and expressive skills as well as academic skill acquisition. When loss is suspected, the practitioner should consult professional literature to further understand the potential impact of a documented hearing issue (see the American Speech–Language–Hearing Association guidelines, *www.asha.org*).

With regard to vision, refractive error (i.e., hyperopia and anisometropia), accommodative and vergence dysfunctions, and eye movement disorders are associated with learning difficulties, whereas other vision problems (e.g., constant strabismus and amblyopia) are not. As such, when a vision disorder is documented or suspected, the practitioner should consult professional literature to further understand the impact of the visual disorder (e.g., see American Optometric Association, *www.aoa.org*).

[b]When there is a history of hearing difficulties and an SLD diagnosis is being considered, hearing testing should be recent (i.e., conducted within the past 6 months).

[c]When evaluating the impact of language and cultural factors on a student's functioning, the practitioner should consider whether and to what extent other individuals with similar linguistic and cultural backgrounds as the referred student are progressing and responding to instruction in the present curriculum. For example, if an LEP student with limited English proficiency is not demonstrating academic progress or is not performing as expected on a class- or districtwide assessment when compared to his or her peers who possess a similar level of English proficiency and acculturative knowledge, it is unlikely that cultural and linguistic differences are the sole or primary factors for the referred student's low performance. In addition, it is important to note that as the number of cultural and linguistic differences in a student's background increase, the likelihood becomes greater that poor academic performance is attributable primarily to such differences rather than to a disability.

Note. All 50 U.S. states specify eight exclusionary criteria. Namely, learning difficulties cannot be primarily attributed to (1) visual impairment; (2) hearing impairment; (3) motor impairment; (4) intellectual disability; (5) emotional disturbance; (6) environmental disadvantage; (7) economic disadvantage; and (8) cultural difference. Certain states have adopted additional exclusionary factors including autism (CA, MI, VT, and WI), emotional stress (LA and VT), home or school adjustment difficulties (LA and VT), lack of motivation (LA and TN), and temporary crisis situation (LA, TN, and VT). We have integrated these additional criteria under "Social-Emotional/Psychological Factors" and "Environmental/Economic Factors," and have added two further categories (namely, "Instructional Factors" and "Physical/Health Factors") to this form. This form may be reproduced and disseminated.

Note. Developed by Jennifer T. Mascolo and Dawn P. Flanagan. This form may be reproduced and disseminated.

FIGURE 22.3. *(continued)*

cognitive performance (see Figure 22.2, level III, column 4). Practitioners should seek out and gather data from other sources as a means of providing corroborating evidence for standardized test findings. For example, when test findings are found to be consistent with a child's performance in the classroom, more confidence may be placed on test performance because interpretations of cognitive deficiency have ecological validity—an important condition for any diagnostic process (Flanagan et al., 2013; Flanagan, Alfonso, Sy, et al., 2018; Hale & Fiorello, 2004). Table 22.4 provides an example of the cognitive abilities and neuropsychological processes measured by the Wechsler Intelligence Scale for Children—Fifth Edition (WISC-V; Wechsler, 2014), the Woodcock–Johnson IV Tests of Cognitive Abilities (Schrank, McGrew, & Mather, 2014), and the Kaufman Assessment Battery for Children, Second Edition Normative Update (Kaufman & Kaufman, 2018). For similar information on all major intelligence tests and neuropsychological instruments, see Flanagan and colleagues (2017).

A particularly salient aspect of the DD/C operational definition of SLD is the concept that a weakness or deficit in a cognitive ability or process underlies difficulties in academic performance or skill development. Because research demonstrates

TABLE 22.4. Cognitive Abilities and Neuropsychological Processes Measured by the Wechsler Intelligence Scale for Children—Fifth Edition (WISC-V), Woodcock–Johnson IV Tests of Cognitive Abilities (WJ IV COG), and Kaufman Assessment Battery for Children II Normative Update (KABC-II NU) Subtests

	CHC broad and narrow abilities							Neuropsychological domains							
Subtest	Gf	Gc	Gsm	Gv	Gs	Ga	Glr	Sensory–motor	Speed and efficiency	Attention	Visual-spatial (RH) and detail (LH)	Auditory–verbal	Memory and/or learning	Executive	Language[a]
					WISC-V										
Arithmetic[b]	✓ (RQ)		✓ (MW)							✓		✓	✓	✓	✓[R]
Block Design				✓ (Vz)				✓			✓			✓	
Cancellation					✓ (P)			✓	✓	✓	✓			✓	
Coding					✓ (R9)			✓	✓	✓	✓		✓	✓	
Comprehension		✓ (K0)										✓	✓		✓[E/R]
Delayed Symbol Translation							✓ (MA)			✓			✓	✓	
Digit Span			✓ (MS, MW)							✓		✓	✓	✓	
Figure Weights	✓ (RG)									✓	✓			✓	
Information		✓ (K0)										✓	✓		✓[E]
Immediate Symbol Translation							✓ (MA)			✓			✓	✓	
Letter–Number Sequencing			✓ (MW)							✓		✓	✓	✓	
Matrix Reasoning	✓ (I)										✓			✓	
Naming Speed Literacy							✓ (NA)		✓	✓	✓		✓		
Naming Speed Quantity					✓ (N)				✓	✓	✓		✓		
Picture Concepts	✓ (I)									✓	✓		✓		

(continued)

TABLE 22.4. *(continued)*

	CHC broad and narrow abilities							Neuropsychological domains							
Subtest	Gf	Gc	Gsm	Gv	Gs	Ga	Glr	Sensory–motor	Speed and efficiency	Attention	Visual-spatial (RH) and detail (LH)	Auditory–verbal	Memory and/or learning	Executive	Language[a]
Picture Span			✓ (MS)								✓		✓	✓	
Recognition Symbol Translation							✓ (MA)			✓			✓	✓	
Similarities		✓ (VL)										✓	✓	✓	✓[E]
Symbol Search					✓ (P)			✓	✓	✓	✓			✓	
Visual Puzzles				✓ (Vz)						✓	✓			✓	
Vocabulary		✓ (VL)										✓	✓		✓[E]
WJ IV COG															
Analysis–Synthesis	✓ (RG)										✓	✓	✓	✓	✓[R]
Concept Formation	✓ (I)										✓	✓	✓	✓	✓[R]
General Information		✓ (K0)										✓	✓		✓[R/E]
Letter–Pattern Matching					✓ (P)				✓	✓	✓				
Memory for Words			✓ (MS)							✓		✓	✓		
Nonword Repetition			✓ (MS)			✓ (UM)				✓		✓			
Number–Pattern Matching					✓ (P)				✓	✓	✓				
Numbers Reversed			✓ (MW)							✓		✓	✓	✓	
Number Series	✓ (RQ)								✓		✓				
Object–Number Sequencing			✓ (MW)							✓		✓	✓		

(continued)

TABLE 22.4. *(continued)*

	CHC broad and narrow abilities							Neuropsychological domains							
Subtest	Gf	Gc	Gsm	Gv	Gs	Ga	Glr	Sensory–motor	Speed and efficiency	Attention	Visual-spatial (RH) and detail (LH)	Auditory–verbal	Memory and/or learning	Executive	Language[a]
Oral Vocabulary		✓ (VL)										✓	✓		✓[E]
Pair Cancellation					✓ (P)				✓	✓	✓				
Phonological Processing						✓ (PC)				✓		✓			
Picture Recognition				✓ (MV)						✓	✓		✓		
Story Recall							✓ (MM)			✓		✓			✓[E]
Verbal Attention			✓ (MW)							✓		✓			
Visual–Auditory Learning							✓ (MA)			✓			✓	✓	
Visualization					✓ (Vz)					✓	✓			✓	
					KABC-II NU										
Atlantis							✓ (MA)				✓		✓	✓	
Atlantis Delayed							✓ (MA)				✓		✓	✓	
Block Counting					✓ (Vz)						✓				
Conceptual Thinking	✓ (I)				✓ (Vz)						✓			✓	
Expressive Vocabulary		✓ (VL)										✓	✓		✓[E]
Face Recognition					✓ (MV)					✓	✓		✓		
Gestalt Closure					✓ (CS)						✓		✓		
Hand Movements			✓ (MS, MV)					✓		✓	✓		✓		

(continued)

TABLE 22.4. *(continued)*

	CHC broad and narrow abilities							Neuropsychological domains							
Subtest	Gf	Gc	Gsm	Gv	Gs	Ga	Glr	Sensory–motor	Speed and efficiency	Attention	Visual-spatial (RH) and detail (LH)	Auditory–verbal	Memory and/or learning	Executive	Language[a]
Number Recall			✓ (MS)							✓		✓	✓		
Pattern Reasoning	✓ (I)				✓ (Vz)						✓			✓	
Rebus							✓ (MA)					✓	✓	✓	
Rebus Delayed							✓ (MA)					✓	✓	✓	
Riddles	✓ (RG)	✓ (VL)										✓	✓	✓	✓R/E
Rover	✓ (RG)			✓ (SS)							✓			✓	
Story Completion	✓ (RG)	✓ (K0)									✓		✓	✓	
Triangles				✓ (Vz)				✓			✓			✓	
Verbal Knowledge		✓ (VL, K0)										✓	✓		✓R
Word Order			✓ (MS, MW)							✓		✓	✓	✓	

Note. Gf, fluid intelligence; Gc, crystallized intelligence; Gsm, short-term memory; Gv, visual processing; Gs, processing speed. RQ, quantitative reasoning; MW, working memory; SR, spatial relations; Vz, visualization; P, perceptual speed; R9, rate of test taking; K0, general (verbal) knowledge; LD, language development; MS, memory span; I, induction; RG, general sequential reasoning; CF, flexibility of closure; VL, lexical knowledge. The following Cattell–Horn–Carroll (CHC) broad abilities are omitted from this table because none is a primary ability measured by the WISC-V: Glr (long-term storage and retrieval), Ga (auditory processing), Gt (decision/reaction time or speed), and Grw (reading and writing ability). Most CHC test classifications are from Flanagan, Ortiz, and Alfonso (2017). Classifications according to neuropsychological domains were based on our readings of neuropsychological texts (e.g., Fletcher-Janzen & Reynolds, 2008; Hale & Fiorello, 2004; Lezak, 1995; Miller, 2007, 2010) and are also found in Flanagan, Alfonso, and Mascolo (2011).

[a]E, expressive; R, receptive.

[b]Cognitive ability classifications for the Arithmetic subtest are based on analyses conducted by Keith, Fine, Taub, Reynolds, and Kranzler (2006; viz., Gf:RQ). It is important to note that the Keith et al. analyses did not include any other measures of math achievement; therefore, Gq was not represented adequately in their study. Arithmetic has been identified in many other studies as a measure of Gq, particularly math achievement (A3) (see, for discussions, Flanagan & Alfonso, 2017; Flanagan & Kaufman, 2009).

that the relationship between the cognitive dysfunction and the manifest learning problems is causal in nature[2] (e.g., Flanagan & Schneider, 2016; Fletcher, Lyon, Fuchs, & Barnes, 2007; Fletcher, Taylor, Levin, & Satz, 1995; Hale & Fiorello, 2004; Hale et al., 2010; Wagner & Torgesen, 1987), data analysis at this level should seek to ensure that identified weaknesses or deficits on cognitive and neuropsychological tests bear an empirical relationship to those weaknesses or deficits in achievement identified previously. It is this very notion that makes it necessary to draw upon cognitive and neuropsychological theory and research to inform operational definitions of SLD and increase the reliability and validity of the SLD identification process. Theory and its related research base not only specify the relevant constructs that ought to be measured at levels I and III, but predict the way they are related. Furthermore, application of current theory and research provides a substantive empirical foundation from which interpretations and conclusions may be drawn. Tables 22.5 through 22.7 provide summaries of the relations between CHC cognitive abilities and processes and reading, math, and writing achievement, respectively, based on findings from multiple literature reviews (Berninger, 2011; Flanagan, Ortiz, Alfonso, & Mascolo, 2006; Flanagan et al., 2013; McDonough et al., 2017; McGrew & Wendling, 2010; Niileksela, Reynolds, Keith, & McGrew, 2016). These tables also provide summaries of the literature on the etiology of academic difficulties (see McDonough et al., 2017, for a discussion).

The information contained in Tables 22.5 through 22.7 may be used to guide how practitioners organize their assessments at this level. That is, prior to selecting cognitive and neuropsychological tests, a practitioner should have knowledge of those cognitive abilities and processes that are most important for understanding a child's academic performance in the area(s) in question (i.e., the area[s] identified as weak or deficient at level I). Evaluation of cognitive performance should be comprehensive in the areas of suspected dysfunction. Because evidence of a cognitive weakness or deficit is a necessary condition for SLD determination, if no weaknesses or deficits in cognitive abilities or processes are found, then an essential criterion for SLD determination is not met. When the criterion at level III is not met, an evaluation of whether the obtained cognitive data represent an evaluation that was sufficient in breadth and depth vis-à-vis what is known about the relations between abilities, processes, and academic skill acquisition and development is warranted. Furthermore, a more in-depth exploration of exclusionary factors evaluated at level II may be warranted.

Also, because new data are gathered at level III, it is now possible to evaluate the exclusionary factors that could not be evaluated earlier (e.g., ID). The circular arrows between levels II and III in Figure 22.2 are meant to illustrate that interpretations and decisions based on data gathered at level III may need to be informed by data gathered at level II. Likewise, data gathered at level III are often necessary to rule out (or in) one or more factors listed at level II in Figure 22.2. Reliable and valid identification of SLD depends in part on being able to understand academic performance (level I), cognitive performance (level III), and the many factors that may facilitate or inhibit such performances (level II).

Level IV: Data Integration—The DD/C Pattern of Strengths and Weaknesses

The fourth level of evaluation involves an analysis of the individual's PSW. It revolves around a theory- and research-guided examination of performance across academic skills, cognitive abilities, and neuropsychological processes to determine whether the child's PSW is consistent with the SLD construct.

Figure 22.4 provides an illustration of three common components of the PSW method for identification of SLD. First, individuals with SLD have cognitive processing weaknesses or deficits. These weaknesses are depicted by the bottom left oval in the figure. Second, individuals with SLD have academic skill weaknesses or deficits. These weaknesses are depicted by the bottom right oval in the figure. Third, individuals with SLD have areas of cognitive strength. These strengths are depicted in the top center oval in the figure. In addition to these three components, the relationships between these ovals are important. The double-headed arrows between the top oval and the two bottom ovals in the figure indicate the presence of statistically significant discrepancies in measured performance between cognitive strengths and the areas of academic and cognitive weakness. These discrepancies denote that the differences are reliable and not due to chance. The double-headed arrow between the two bottom ovals reflects a consistency between the cognitive and academic areas of weakness. The consistency

TABLE 22.5. Summary of Relations among CHC Domains, Reading Achievement, and the Etiology of Reading Functions

CHC broad ability	Reading achievement	Etiology of reading functions
Gf	Inductive (I) and general sequential reasoning (RG) abilities play a moderate role in reading comprehension. Executive functions (EF), such as planning, organization, and self-monitoring, are also important.	Several cortical and subcortical structures are frequently implicated in basic reading skills and word-reading accuracy. Recent work appears to identify dysfunction in a left-hemispheric network that includes the occipito-temporal region, inferior frontal gyrus, and inferior parietal region of the brain (Fletcher, Simos, Papanicolaou, & Denton, 2004; Richlan, 2012; Richlan et al., 2009; Shaywitz et al., 2000; Silani et al., 2005). Numerous imaging studies have also found that dysfunctional responses in the left inferior frontal and temporo-parietal cortices play a significant role with regard to phonological deficits (Skeide et al., 2015). Similar brain regions are activated on tasks involving reading fluency, but additional activation is observed in areas involved in eye movement and attention (Jones, Ashby, & Branigan, 2013). Furthermore, there is also evidence for increased activation in the left occipito-temporal region, in particular the occipito-temporal sulcus, which is important for rapid processing of letter patterns (Dehaene & Cohen, 2011; Shaywitz et al., 2004).
Gc	Language development (LD), lexical knowledge (VL), and listening ability (LS) are important at all ages for reading acquisition and development. These abilities become increasingly important with age. Oral language, listening comprehension, and EF (planning, organization, self-monitoring) are also important for reading comprehension.	
Gwm	Memory span (MS) and working memory capacity (WM) or attentional control are important for overall reading success. Phonological memory or WM for verbal and sound-based information may also be important. WM is important for reading comprehension, which involves holding words and sentences in awareness, while integrating prior knowledge with incoming information.	
Gv	Orthographic processing (often measured by tests of perceptual speed that use orthographic units as stimuli) is related to reading rate and fluency. Orthographic processing involves the ability to process units of words based on visual long-term memory representations, which is critical for automatic word recognition.	Brain regions often associated with reading comprehension include the anterior temporal lobe, inferior temporal gyrus, inferior frontal gyrus, inferior frontal sulcus, and middle and superior frontal and temporal regions (Ferstl et al., 2008; Gernsbacher & Kaschak, 2003). More recent research has revealed a relationship between listening and reading comprehension and activation along the left superior temporal sulcus, which has referred to by some as the *comprehension cortex* (Berl et al., 2010). However, broader pathways are also activated in reading comprehension, reflecting increased cognitive demand compared to listening.
Ga	Phonetic coding (PC) or phonological awareness/processing is very important during the elementary school years for the development of basic reading skills and word-reading accuracy. Phonological memory or WM for verbal and sound-based information may also be important.	
Glr	Naming facility (NA) or rapid automatic naming (RAN; also called speed of lexical access) is very important during the elementary school years for reading rate and fluency or word recognition skills. Associative memory (MA) is also important.	Family and genetic factors have long been identified as crucial in reading achievement, with some researchers suggesting that a child with a parent with a reading disability is eight times more likely to have dyslexia than a child in the general population (Pennington & Olson, 2005).
Gs	Perceptual speed (P) abilities are important throughout school, but particularly during the elementary school years.	Shared environmental factors include language and literacy environment during childhood (Wadsworth et al., 2000) and quality of reading instruction.

Note. Information in this table was culled from the following sources: Flanagan, Ortiz, and Alfonso (2013); Flanagan, Ortiz, Alfonso, and Mascolo (2006); McDonough, Flanagan, Sy, and Alfonso (2017); McGrew and Wendling (2010); Niileksela, Reynolds, Keith, and McGrew, 2016. All references cited in the "Etiology . . ." column may be found in these sources.

TABLE 22.6. Summary of Relations among CHC Domains, Math Achievement, and the Etiology of Math Functions

CHC broad ability	Math achievement	Etiology of math functions
Gf	Reasoning inductively (I) and deductively with numbers (RQ) is very important for math problem solving. Executive functions such as set shifting and cognitive inhibition are also important.	The intraparietal sulcus in both hemispheres is widely viewed as crucial in processing and representing numerical quantity (number sense), although there may be differences in activation as a function of age (Ansari & Dhital, 2006; Ansari, Garcia, Lucas, Hamon, & Dhital, 2005; Dehaene et al., 2004; Kaufmann et al., 2006; Kucian, von Aster, Loenneker, Dietrich, & Martin, 2008; Mussolin et al., 2010; Price & Ansari, 2013).
Gc	Language development (LD), lexical knowledge (VL), and listening ability (LS) are important at all ages for math problem solving. These abilities become increasingly important with age. Number representation (e.g., quantifying sets without counting, estimating relative magnitude of sets) and number comparisons are related to overall number sense.	
Gwm	Memory span (MS) and working memory capacity (WM) or attentional control are important for math problem solving and overall success in math.	Regions of the left fronto-parietal cortex, including the intraparietal sulcus, angular gyrus, and supramarginal gyrus, have been consistently associated with math calculation (Ansari, 2008; De Smedt, Holloway, & Ansari, 2011; Dehaene, Molko, Cohen, & Wilson, 2004; Dehaene et al., 2004). The dorsolateral prefrontal cortex has also been found to show increased activation during calculation, implying that executive functioning and working memory may be playing a role in the process (Davis et al., 2009).
Gv	Visualization (VZ), including mental rotation, is important primarily for higher-level math (e.g., geometry, calculus) and math problem solving.	
Ga		A left-hemisphere network that includes the precentral grytus, inferior parietal cortex, and intraparietal sulcus is often implicated in math fact retrieval (Dehaene & Cohen, 1992, 1997; Dehaene et al., 1999). Furthermore, some researchers believe that rote math facts are retrieved from verbal memory, thereby requiring activation of the angular gyrus and other regions associated with linguistic processes (Dehaene, 1992; Dehaene & Cohen, 1995; Dehaene et al., 1999).
Glr	Naming facility (NA; also called speed of lexical access) and associative memory (MA) are important for memorization and rapid retrieval of basic math facts and for accurate and fluent calculation.	
Gs	Perceptual speed (P) is important during all years, especially the elementary school years for math calculation fluency.	Prevalence of math disabilities is about 10 times higher in those with family members who had math disabilities than in the general population (Shalev et al., 2001).
		Environmental factors, including motivation, emotional functioning (e.g., math anxiety), and suboptimal or inadequate teaching, may also contribute to math difficulties (Szucs & Goswami, 2013; Vukovic et al., 2013). Furthermore, math achievement may be associated with cultural or gender-based attitudes that may be transmitted in the family environment (e.g., Chiu & Klassen, 2010; Gunderson et al., 2011).

Note. Information in this table was culled from the following sources: Flanagan, Ortiz, and Alfonso (2013); Flanagan, Ortiz, Alfonso, and Mascolo (2006); McDonough, Flanagan, Sy, and Alfonso (2017); McGrew and Wendling (2010); and McGrew et al. (2014). All references cited in the "Etiology . . ." column may be found in these sources.

TABLE 22.7. Summary of Relations between CHC Domains and Writing Achievement and the Etiology of Writing Functions

CHC broad ability	Writing achievement	Etiology of writing functions
Gf	Inductive (I) and general sequential reasoning (RG) are consistently related to written expression at all ages. Executive functions such as attention, planning, and self-monitoring are also important.	Neural correlates of writing are less understood, but some studies have suggested that the cerebellum and parietal cortex, particularly the left superior parietal lobe, may be involved (Katanoda et al., 2001; Magrassi et al., 2010). In addition, the frontal lobes have also been implicated and are considered crucial in planning, brainstorming, organizing, and goal setting, which are important for written expression (Shah et al., 2013). Functional neuroimaging studies have provided substantial evidence for the role of the ventral-temporal inferior frontal gyrus and the posterior inferior frontal gyrus in spelling (Rapp et al., 2015; van Hoorn et al., 2013). Other areas that have been identified include the left ventral cortex, bilateral lingual gyrus, and bilateral fusiform gyrus (Planton et al., 2013; Purcell et al., 2014; Richards et al., 2005, 2006). However, many of these regions have also been associated with reading and are not distinct to spelling/writing disorders. Although there is a significant genetic component involved in the development of writing skills, this etiology is often shared with a broad variety of reading and language skills (Olson et al., 2013).
Gc	Language development (LD), lexical knowledge (VL), and general information (K0) are important primarily after second grade and become increasingly important with age. Level of knowledge of syntax, morphology, semantics, and VL has a significant impact on clarity of written expression and text generation ability.	
Gwm	Memory span (MS) is important to writing, especially spelling skills, whereas working memory (WM) has shown relations with advanced writing skills (e.g., written expression, synthesizing multiple ideas, ongoing self-monitoring).	
Gv	Orthographic processing (often measured by tests of perceptual speed that use orthographic units as stimuli) is particularly important for spelling.	
Ga	Phonetic coding (PC) or phonological awareness/processing is very important during the elementary school years (primarily before fifth grade) for both basic writing skills and written expression.	
Glr	Naming facility (NA; also called speed of lexical access) has demonstrated relations with writing fluency. Storing and retrieving commonly occurring letter patterns in visual and motor memory are needed for spelling.	
Gs	Perceptual speed (P) is important during all school years for basic writing skills and is related to written expression at all ages.	

Note. Information in this table was culled from the following sources: Flanagan, Ortiz, and Alfonso (2013); Flanagan, Ortiz, Alfonso, and Mascolo (2006); McDonough, Flanagan, Sy, and Alfonso (2017); McGrew and Wendling (2010); and McGrew et al. (2014). All references cited in the "Etiology . . ." column may be found in these sources.

means that underlying cognitive processing weaknesses or deficits impede the typical development of basic academic skills in individuals with SLD. The cognitive and academic PSW represented in Figure 22.4 retains the component of unexpected underachievement that has historically been synonymous with the SLD construct (Kaufman, 2008; Kavale & Forness, 2000; Sotelo-Dynega et al., 2018), and adds an underlying cognitive processing component that was missing from traditional discrepancy approaches. The manner in which all components of the pattern are defined varies, sometimes quite substantially, between models. Figure 22.4 includes wording that is most consistent with the DD/C model, and each component of this PSW model is described next.

When the process of SLD identification has reached level IV, three *preliminary* criteria for SLD identification have been met: (1) one or more weaknesses or deficits in academic performance; (2) one or more weaknesses or deficits in cognitive abilities and/or neuropsychological processes; and (3) exclusionary factors determined not to be the primary causes of the academic and cognitive weaknesses or deficits. What has not been determined, however, is whether the pattern of results is marked by an empirical or ecologically valid relationship between the identified cognitive and academic weaknesses; whether the individual's cognitive weakness is *domain-specific*; whether the individual's academic weakness (underachievement) is *unexpected*; and whether the individual displays at least average ability to think and reason. These four conditions form a specific PSW that is marked by two discrepancies and a consistency (DD/C). Within the context of the DD/C operational definition, the nature of unexpected underachievement suggests that not only does a child have specific, circumscribed, and related academic and cognitive weaknesses or deficits—referred to as a *below-average cognitive aptitude–achievement consistency*—but that these weaknesses exist along with generally average or better ability to think and reason (i.e., overall average cognitive ability). These four conditions form a specific PSW that is marked by two discrepancies and a consistency (DD/C). The Cross-Battery Assessment Software System (X-BASS; Flanagan et al., 2017) is needed to determine whether the data demonstrate the DD/C pattern because specific formulae, regression equations, correction for false negatives, and so forth are necessary to make the determination (for explanations of how X-BASS conducts a PSW analysis, see Flanagan et al., Chapter 27, this volume; Flanagan, Alfonso, Sy, et al., 2018). Each of these four conditions is described below.

Consistency between Cognitive and Academic Weaknesses

A student with an SLD has specific cognitive and academic weaknesses or deficits. When these weaknesses are related empirically, or when there is an ecologically valid relationship between them, the relationship is referred to as a *below-average cognitive aptitude–achievement consistency* in the DD/C operational definition. This consistency is a necessary marker for SLD because SLD is caused in part by cognitive processing weaknesses or deficits. Thus there is a need to understand and identify the underlying cognitive ability or processing problems that contribute significantly to the individual's academic difficulties.

The term *cognitive aptitude* within the context of the DD/C operational definition represents the specific cognitive ability or neuropsychological processing weaknesses or deficits that are related empirically to the academic skill weaknesses or deficits. For example, if a child's basic reading skill deficit is related to cognitive deficits in phonological processing (a narrow Ga ability) and rapid automatic naming (a narrow Gr ability), then the combination of below-average Ga and Gr performances represents his or her *below-average cognitive aptitude for basic reading,* meaning that these below-average performances *raise the risk* of a weakness in basic reading skills (Flanagan & Schneider, 2016). Moreover, the finding of below-average performance on measures of phonological processing, rapid automatic naming, and basic reading skill represents a *below-average cognitive aptitude–achievement consistency* (or, more specifically, a below-average *reading* cognitive aptitude–*reading* achievement consistency). The concept of below-average cognitive aptitude–achievement consistency reflects the notion that there are documented relationships between specific cognitive abilities and processes and specific academic skills (see Tables 22.5–22.7). Therefore, the finding of below-average performance in related cognitive and academic areas is an important marker for SLD in the DD/C operational definition, and in other alternative research-based approaches (e.g., McCloskey et al., 2012; see Alfonso & Flanagan, 2018, for support of this SLD marker in other PSW models).

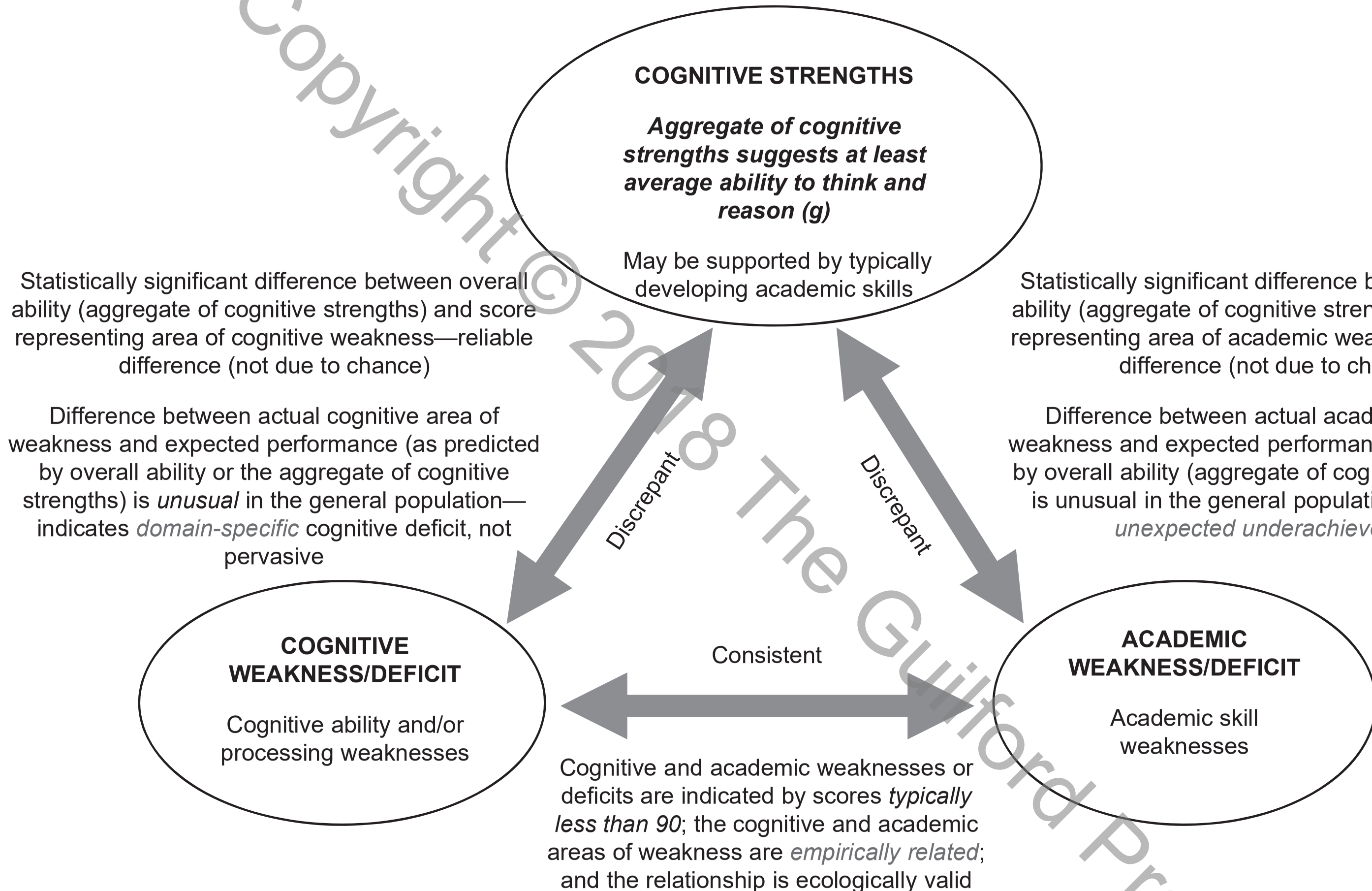

FIGURE 22.4. Conceptual understanding of the dual-discrepancy/consistency (DD/C) method. This figure is based on the work of Flanagan, Fiorello, and Ortiz (2010) and Hale, Flanagan, and Naglieri (2008). However, the wording in this figure is consistent wiht Flanagan, Ortiz, and Alfonso's (2013) DD/C model.

In the DD/C definition, the criteria for establishing a below-average cognitive aptitude–achievement *consistency* are as follows:

1. "Below-average" performance (i.e., scores of less than 90, and more typically at least a standard deviation or more below the mean) in the specific cognitive *and* academic areas that are considered weaknesses or deficits; and
2. Evidence of an empirical relationship between the specific cognitive and academic areas of weakness and/or an ecologically valid relationship between these areas. To validate the relationship between the cognitive and academic areas of weakness, practitioners can document the way each cognitive weakness or deficit manifests itself in real-world performances (see Mascolo, Alfonso, & Flanagan, 2014, for guidance).

It is important to understand that these criteria are operationalized further in X-BASS. Table 22.8 provides a more detailed explanation of how a consistency between cognitive and academic weaknesses is determined by X-BASS.

When the criteria for a below-average cognitive aptitude–achievement consistency are met, there may or may not be a nonsignificant difference between the scores that represent the cognitive and academic areas of weakness. That is, in the DD/C definition, *consistency* refers to the fact that an empirical or ecologically valid relationship exists between the areas of identified cognitive and academic weakness, but not necessarily a nonsignificant difference between these areas. While a nonsignificant difference between the areas of cognitive and academic weakness would be expected, it need not be an inclusionary criterion for SLD. Because many factors facilitate and inhibit performance, a student may perform better or worse academically than his or her cognitive weaknesses may suggest (for a discussion, see Flanagan & Schneider, 2016; Flanagan et al., 2013; Flanagan, Alfonso, Sy, et al., 2018).

Discovery of consistencies among cognitive abilities and/or processes and academic skills in the below-average (or lower) range could result from ID, developmental disabilities, or generally below-average cognitive ability (this would negate two important markers of SLD: that cognitive weaknesses are domain-specific and that underachievement is unexpected) (see Lovett & Kilpatrick, 2018). Therefore, identification of SLD cannot rest on below-average cognitive aptitude–achievement consistency alone. A child with SLD typically has many cognitive capabilities. Therefore, in the DD/C definition, the child must also demonstrate at least average ability to think and reason (i.e., standard scores generally ≥ 85), despite cognitive weaknesses or deficits. For example, in the case of a young child with reading decoding difficulties, it would be necessary to determine that performance in areas less related to this skill (e.g., Gf, math ability) are about average or better. Such a finding would suggest that the related weaknesses in cognitive and academic domains are not due to a more pervasive form of cognitive dysfunction, thus supporting the notion of *unexpected underachievement*—that the child would be likely to perform within normal limits (e.g., at or close to grade level) in whatever achievement skill he or she was found to be deficient in, if not for *specific* cognitive ability or processing weaknesses or deficits. Moreover, because the child has generally average or better ability to think and reason, the academic skill deficiency is indeed unexpected. In sum, the finding of a pattern of circumscribed and related weaknesses (i.e., below-average cognitive aptitude–achievement consistency), despite at least average ability to think and reason (or a pattern of strengths) is convincing evidence of SLD—particularly when the student who demonstrates this pattern did not respond well to high-quality instruction, and when exclusionary factors were ruled out as the primary causes of the deficits.

At Least Average Ability to Think and Reason

An SLD is just what its full name indicates: *specific*. It is not general. As such, the below-average cognitive aptitude–achievement consistency ought to be circumscribed and represent a level of functioning significantly different from the student's cognitive capabilities or strengths in other areas. Indeed, the notion that students with SLD are of generally average or better overall cognitive ability is well known and has been written about for decades (e.g., Hinshelwood, 1917; Orton, 1937). In fact, the earliest recorded definitions of learning disability were developed by clinicians, based on their observations of individuals who experienced considerable difficulties with the acquisition of basic academic skills, despite their average or above-average general intelligence. According to Monroe (1932), "The children of superior mental capacity who fail to learn to read are, of course, spectacular examples of specific reading difficulty since they have such

TABLE 22.8. Description of the Below-Average Aptitude–Achievement Consistency of the DD/C Model and How It Is Determined by Using X-BASS

DD/C	X-BASS	Comments
Areas of cognitive and academic weakness are below average, and there is an empirical and/or ecologically valid relationship between them.	For this component of the PSW analysis, X-BASS answers two specific questions and based on the answers to those questions, provides a statement about the presence of below-average aptitude–achievement consistency. The first question is "Are the scores that represent the cognitive and academic areas of weakness actually weaknesses as compared to these areas in most people (i.e., below average or lower compared to same-age peers from the general population)?" The program parses the cognitive and academic weakness scores into three levels: < 85, 85–89 inclusive, and ≥90. Scores less than 85 are considered *normative* weaknesses; scores between 85 and 89 (inclusive) are considered weaknesses because they are below average; and scores of 90 or higher are not considered to be weaknesses. Next, the two scores (academic and cognitive) are examined relative to each other. When both scores are less than 85, the program will report a "Yes," meaning that both scores are normative weaknesses. If one score is less than 85 and the other is between 85 and 89, the program will report "Likely." If both scores are between 85 and 89 (inclusive), the program reports "Possibly" (because the scores are within normal limits, despite being classified as below average). The program will also report "Possibly" when one score is less than 85 and one is 90 or higher. If one score is between 85 and 89 (inclusive) and the other is 90 or higher, the program reports "Unlikely" and when both scores are 90 or higher, the program reports "No," indicating that the scores cannot be considered weaknesses as compared to most people. The second question is "Are the areas of cognitive and academic weakness related empirically?" The strength of the relationship between the cognitive and academic areas of weakness is reported automatically by X-BASS as either LOW (median intercorrelation < .30), MODERATE or MOD) (median intercorrelation between .30 and .50), or HIGH (median intercorrelation > .50), based on a review of the literature (see Flanagan, Ortiz, & Alfonso, 2013; McGrew & Wendling, 2010) and the technical manuals of cognitive and intelligence batteries (e.g., WJ IV, WISC-V). Information regarding where the cognitive and academic weakness scores fall as compared to those for most people, and the strength of the relationship between the two areas, is used to answer the question "Is there a below-average aptitude–achievement consistency?" The answer automatically generated by X-BASS will be either "Yes, Consistent," "No, Not Consistent," or "Possibly, Use Clinical Judgment." For example, if the cognitive and academic areas selected by the evaluator as weaknesses are associated with scores that fall below 85 and if the strength of the relationship between the areas of cognitive and academic weakness is moderate or high, then the program will report "Yes, Consistent."	In some cases, the answer to the question of whether or not an individual's PSW is marked by a below-average aptitude–achievement consistency may not be clear from the quantitative data alone. As such, it is always important to interpret an individual's PSW within the context of all available data sources (e.g., exclusionary factors, behavioral observations, work samples) and render a judgment about SLD based on the totality of the data.

obvious abilities in other fields" (p. 23; cf. Mather, 2011). Indeed, "all historical approaches to SLD *emphasize the spared or intact abilities* that stand in stark contrast to the deficient abilities" (Kaufman, 2008, pp. 7–8; emphasis added).

Current definitions of SLD also recognize the importance of generally average or better overall ability as a characteristic of individuals with SLD. For example, the official definition of learning disability of the Learning Disabilities Association of Canada states in part, "Learning Disabilities refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who *otherwise demonstrate at least average abilities essential for thinking and/or reasoning*" (*www.ldac-acta.ca/learn-more/ld-defined*, emphasis added; see also Harrison & Holmes, 2012).

Unlike some definitions of SLD, such as Canada's, the IDEA 2004 definition does not refer to overall cognitive ability level. However, the 2006 federal regulations contain the following phrasing: "(ii) The child exhibits a pattern of strengths and weaknesses in performance, achievement, or both, relative to age, State-approved grade-level standards, or intellectual development, that is determined by the group to be relevant to the identification of a specific learning disability" (U.S. Department of Education, 2006). Given the vagueness of the wording in the federal regulations, one could certainly infer that this phrase means that the cognitive and academic areas of concern are significantly lower than what is expected, relative to those of same-age peers or relative to otherwise average intellectual development. Indeed, there continues to be considerable agreement that a student who meets criteria for SLD has *some* cognitive capabilities that are at least average in relation to those of most people (e.g., Alfonso & Flanagan, 2018; Berninger, 2011; Feifer, 2012; Fiorello, Flanagan, & Hale, 2014; Flanagan & Alfonso, 2017; Geary et al., 2011; Hale & Fiorello, 2004; Hale et al., 2011; Harrison & Holmes, 2012; Kaufman, 2008; Kavale & Flanagan, 2007; Kavale & Forness, 2000; Kavale et al., 2009; Mather & Wendling, 2011 and Chapter 28, this volume; McCloskey et al., 2012; Naglieri & Feifer, 2018; Shaywitz, 2003). Moreover, the criterion of overall average or better cognitive ability (despite specific cognitive processing weaknesses) is necessary for differential diagnosis (see Lovett & Kilpatrick, 2018).

When a student does not meet criteria specified in the DD/C operational definition of SLD, it is possible that the student exhibits *slow learning* (SL; i.e., below-average ability to learn and achieve). However, by failing to differentially diagnose SLD from SL or other conditions that impede learning (such as ID or pervasive developmental disorders), the SLD construct loses its meaning, and there is a tendency (albeit well intentioned) to accept anyone under the SLD category who has learning difficulties for reasons other than specific cognitive dysfunction (e.g., Kavale & Flanagan, 2007; Kavale, Kauffman, Bachmeier, & LeFever, 2008; Lovett & Kilpatrick, 2018; Mather & Kaufman, 2006; Reynolds & Shaywitz, 2009a, 2009b). According to Kavale and colleagues (2008, p. 145), "About 14% of the school population may be deemed SL, but this group does not demonstrate unexpected learning failure, but rather an achievement level consonant with IQ level . . . slow learn[ing] has never been a special education category, and 'What should not happen is that a designation of SLD be given to a [child with] slow learning' (Kavale, 2005, p. 555)." Although the underlying and varied causes of the learning difficulties of all students who struggle academically *should be investigated and addressed,* an accurate SLD diagnosis is necessary because it informs instruction (e.g., Hale et al., 2010). As such, it seems prudent for practitioners to adhere closely to the DD/C operational definition of SLD (or other alternative research-based models), so that SLD can be differentiated from other disorders that also manifest themselves in academic difficulty (Berninger, 2011; Della Toffalo, 2010; Lovett & Kilpatrick, 2018).

Although it may be some time before consensus is reached on what constitutes "at least average overall cognitive ability" or "at least average ability to think and reason" for SLD identification, a child who has SLD, *generally speaking,* ought to be able to perform academically at a level approximating that of his or her more typically achieving peers *when provided with individualized instruction as well as appropriate accommodations, and instructional and curricular modifications alongside remedial interventions*. In addition, for a child with SLD to reach performances (in terms of both rate of learning and level of achievement) approximating those of his or her nondisabled peers, the child must possess the ability to learn compensatory strategies and apply them independently; this often requires higher-level thinking and reasoning, including intact executive processes (see Maricle & Avirett, Chapter 36, this volume; McCloskey, Perkins, & Van Divner, 2009). Individuals with SLD can minimize the effects of cognitive processing weaknesses on their ability to access instruction and the curriculum under certain circumstances (Mascolo et al., 2014). Special education provides the mechanism to assist a child with SLD in minimizing or bypassing his or her processing deficits through individualized instruction and intervention and through the provision of appropriate adaptations, accommodations, remediation, and compensatory strategies. However, to succeed in minimizing the effects of an individual's cognitive processing weaknesses in the educational setting to the point of achieving at or close to grade level, at least average overall ability to think and reason is very likely to be requisite, especially in upper elementary school and beyond (see Fuchs & Young, 2006, for a discussion of the mediating effects of IQ on response to intervention). Of course, it is important to understand that while at least average overall ability to think and reason is probably necessary for a child with SLD to be successful at minimizing his or her cognitive processing deficits, many other factors may facilitate or inhibit academic performance, including motivation, determination, perseverance, familial support, quality of individualized instruction, student–teacher relationships, and existence of comorbid conditions (see Flanagan et al., 2012, for a discussion; see also Flanagan & Schneider, 2016).

Determining at least average ability to think and reason for a child who has a below-average cognitive aptitude–achievement consistency is not a straightforward task, and there is no agreed-upon method for determining this condition or even requiring this condition as part of a state's or district's SLD identification guidelines (i.e., it is part of some methods of SLD identification, but not all methods). The main difficulty in determining whether an individual with *specific* cognitive weaknesses has at least average ability to think and reason (as determined by an estimate of *g*)[3] is that the global ability score or scores available on a cognitive or intelligence battery may be attenuated by the cognitive processing weakness(es). Most batteries have a total test score that is an aggregate of *all* (or nearly all) abilities and processes measured by the instrument. As such, in many instances, an individual's specific cognitive weaknesses or deficits attenuate the total test score on these instruments. This problem with ability tests was noted as far back as the 1920s, when Orton stated, "It seems probably that psychometric tests as ordinarily employed give an entirely erroneous and unfair estimate of the intellectual capacity of these [learning disabled] children" (1925, p. 582; cf. Mather, 2011). Perhaps for this reason, intelligence and cognitive ability batteries have become more differentiated, offering a variety of specific cognitive ability composites and options for global ability estimates. Nevertheless, there is increasing agreement that a child who meets criteria for SLD has at least some cognitive capabilities that are indeed average or better (e.g., Berninger, 2011; Flanagan et al., 2008, 2017; Geary et al., 2011; Hale & Fiorello, 2004; Hale et al., 2010; Kaufman, 2008; Kavale & Flanagan, 2007; Kavale & Forness, 2000; Kavale et al., 2009; Naglieri & Feifer, 2018).

To determine whether a child who demonstrates a below-average cognitive aptitude–achievement consistency also has at least average ability to think and reason, consistent with the DD/C model, X-BASS is used (see Flanagan et al., Chapter 27, this volume). The X-BASS provides a means of parceling out cognitive deficits from global functioning and judging the robustness of the spared abilities or cognitive strengths. This program is not meant to replace clinical judgment, but rather to inform it. Others have also developed methods and suggested formulas for determining whether individuals have cognitive strengths that are in stark contrast to their cognitive weaknesses (Naglieri, 2011; see also Fiorello & Wycoff, Chapter 26, this volume). Ultimately, the determination regarding whether a child with a below-average cognitive aptitude–achievement consistency has an SLD (and not SL or ID, for example), or exhibits unexpected (not expected) underachievement, must rely to some extent on clinical judgment.[4] Such judgment, however, is bolstered by converging data from multiple sources that were gathered via multiple methods and clinical tools (Alfonso & Flanagan, 2018; Flanagan & Alfonso, 2011).

Even when it is determined that a student has overall average ability to think and reason, along with a below-average cognitive aptitude–achievement consistency, these findings alone do not satisfy the criteria for a PSW consistent with the SLD construct in the DD/C operational definition. This is because it is not yet clear whether the differences between the score representing overall ability and those representing specific cognitive and academic weaknesses or deficits are statistically significant, meaning that such differences are reliable differences (i.e., not due to chance). Moreover, it is not yet clear whether the cognitive area or areas of weakness are domain-specific, and whether the academic area or areas of weakness (or underachievement) are unexpected.

Domain-Specific Cognitive Weaknesses or Deficits: The First Discrepancy

SLD has been described as a condition that is *domain-specific*. In other words, areas of cognitive weakness or deficit are circumscribed, meaning that while they interfere with learning and achievement, they are not pervasive and do not affect all or nearly all areas of cognition. According to Stanovich (1993), "The key deficit must be a vertical faculty rather than a horizontal faculty—a domain-specific process rather than a process that operates across a variety of domains" (p. 279). It is rare to find an operational definition that specifies a criterion for determining that the condition is "domain-specific." Some suggest that this condition is supported by a statistically significant difference between a student's overall cognitive ability and a score representing the individual's cognitive area of weakness (e.g., Hale & Fiorello, 2004; Naglieri, 2011).

However, a statistically significant difference between two scores means only that the difference is not due to chance; it does not provide information about the *rarity* or infrequency of the difference in the general population. Some statistically significant differences are common in the general population; others are not. Therefore, to determine whether the cognitive area that was identified as a weakness by the evaluator is domain-specific, the difference between the individual's actual and expected performance in this area should be uncommon in the general population.

X-BASS is needed to conduct the calculations necessary (1) to determine if a proxy for *g* can be derived, based on the cognitive areas designated as strengths; and (2) to arrive at an overall ability (*g*) estimate. X-BASS then uses the individual's unique pattern of strengths (proxy for *g*) to predict where the individual was expected to perform in the cognitive domain that is weak, and reports whether the difference between predicted and actual cognitive performance is rare relative to same-age peers (i.e., occurs in about 10% or less of the general population). A rare difference is considered a *domain-specific weakness* (see Flanagan et al., Chapter 27, this volume, for more detail).

Unexpected Underachievement: The Second Discrepancy

Traditionally, ability–achievement discrepancy analysis was used to determine whether an individual's underachievement (e.g., reading difficulty) was unexpected (i.e., the individual's achievement was not at a level commensurate with his or her overall cognitive ability). A particularly salient problem with the ability–achievement discrepancy approach is that a total test score from a cognitive or intelligence test (e.g., Full Scale IQ or FSIQ) is often used as the estimate of overall ability. However, for an individual with SLD, the total test score is often attenuated by one or more specific cognitive weaknesses or deficits, and therefore may provide an unfair or biased estimate of the individual's overall intellectual capacity. Furthermore, when the total test score is attenuated by specific cognitive weaknesses or deficits, the ability–achievement discrepancy is often not statistically significant, which frequently results in denying the student much-needed academic interventions and special education services (e.g., Aaron, 1995; Hale et al., 2011). For this reason, the WISC-V includes the General Ability Index (GAI) as an alternative to the FSIQ and the WJ IV includes the Gf-Gc composite for use in comparison (discrepancy) procedures—an alternative that Flanagan and her colleagues have advocated for many years (e.g., see Appendix H in Flanagan, McGrew, & Ortiz, 2000; Appendix H in Flanagan et al., 2013).

The DD/C operational definition circumvents the problem that plagued traditional ability–achievement discrepancy methods by determining whether the individual has at least average ability to think and reason, *despite one or more cognitive areas of weakness*. As stated above, X-BASS calculates a proxy for *g* when an individual's designated areas of strength are sufficient for this purpose. X-BASS then uses this value to predict where the individual was expected to perform in the academic domain that is weak, and reports whether the difference between predicted and actual academic performance is rare relative to same-age peers (i.e., occurs in about 10% or less of the general population). A rare difference is considered *unexpected underachievement* (see Flanagan et al., Chapter 27, this volume, for more detail).

Level V: SLD's Adverse Impact on Educational Performance

When a child meets criteria for an SLD diagnosis (i.e., when criteria for levels I through IV are met), it is typically obvious that the child has difficulties in daily academic activities that need to be addressed. The purpose of the fifth and final level of evaluation is to determine whether the identified condition (i.e., SLD) impairs academic functioning to such an extent that special education services are warranted.

The legal and diagnostic specifications of SLD necessitate that practitioners review the whole of the collected data and make a professional judgment about the extent of the adverse impact that any measured deficit has on an individual's performance in one or more areas of learning or academic achievement. Essentially, level V analysis serves as a kind of quality control feature designed to prevent the application of an SLD diagnosis in cases in which "real-world" functioning is not in fact impaired or substantially limited, compared to that of same-age peers in the general population—regardless of the patterns seen in the data.

This final criterion requires practitioners to take a very broad survey not only of the entire array of data collected during the assessment, but also of the real-world manifestations and practical implications of any presumed disability. In general, if the criteria at levels I through IV have been met, it is likely that in the majority of cases, level V analysis serves only to support conclusions that have already been drawn. However, in cases where data may be equivocal, level V analysis is an important safety valve, ensuring that any representations of SLD suggested by the data are indeed manifested in observable impairments in one or more areas of functioning in real-life settings.

Children with SLD require individualized instruction, accommodations, and curricular modifications to varying degrees, based on such factors as the nature of the academic setting, the severity of the SLD, the developmental level of each child, the extent to which each child can compensate for specific weaknesses, the way instruction is delivered, the content being taught, and so forth. As such, some children with SLD may not require special education services, such as when their academic needs can be met through classroom-based accommodations (e.g., use of a word bank during writing tasks, extended time on tests) and/or differentiated instruction (e.g., allowing a student with a writing deficit to record reflections on a reading passage and transcribe them outside the classroom prior to submitting a written product). Other children with SLD may require both classroom-based accommodations *and* special education services. And in a case where a child with SLD is substantially impaired in the general education or inclusive setting, a self-contained special education classroom may be required to meet his or her academic needs adequately.

There are two possible questions at Level V that must be answered by the multidisciplinary team (MDT). First, can the child's academic difficulties be remediated, accommodated, or otherwise compensated for without the assistance of individualized special education services? If the answer is yes, then services (e.g., accommodations, curricular modifications) may be provided, and their effectiveness monitored, in the general education setting. If the answer is no, then the MDT must answer the second question: What are the nature and extent of special education services that will be provided to the child? In answering this question, the MDT must ensure that individualized instruction and educational resources are tailored to the child in the least restrictive environment. Furthermore, such interventions should be linked to assessment (i.e., the identified cognitive and academic weaknesses) and should be evidence based.

Summary of the DD/C Operational Definition of SLD

In the preceding paragraphs, we have provided a summary of the DD/C operational definition of SLD. This definition provides a research-based framework for the practice of SLD identification and is likely to be most effective when it is informed by advances in cognitive and neuropsychological theory and research that support (1) the identification and measurement of constructs associated with SLD; (2) the relationships between cognitive abilities and processes and academic skills; and (3) a defensible method of interpreting results. Among the many important components of the definition, we have focused primarily on specifying criteria at the various levels of evaluation to establish the presence of SLD in a manner consistent with IDEA 2004 and its attendant regulations. These criteria include identification of empirically related academic and cognitive abilities and processes in the below-average range, compared to those of same-age peers from the general population; determination that exclusionary factors are not the primary cause of the identified academic and cognitive deficits; and identification of a pattern of performance reflecting domain-specific cognitive weaknesses, unexpected underachievement, and at least average ability to think and reason.

When the quantitative criteria specified at each level of the operational definition are met, as determined by X-BASS, and exclusionary factors have been ruled out as the primary cause of learning difficulties, it may be concluded that the data gathered are sufficient to support a diagnosis or classification of SLD. Because the conditions outlined in Figure 22.2 are based on current SLD research, and the calculations carried out by X-BASS are psychometrically sound, the DD/C operational definition represents progress toward a more complete and defensible approach to the process of evaluating SLD than previous (and many competing) methods (see Flanagan et al., Chapter 27, this volume; Miller, Maricle, & Jones, 2016).

The PSW Approach in Perspective

Given its increasing popularity, research on the PSW approach is emerging. One emerging body of research indicates that there is a lack of agreement among PSW models. This research also suggests that PSW models are effective at determining *who does not have SLD,* but they are not as effective at determining *who does have SLD*. Valid points are made about potential weaknesses of PSW models in this literature (e.g., Kranzler, Floyd, Benson, Zaboski, & Thibodaux, 2016a, 2016b; Miciak, Fletcher, Stuebing, Vaughn, & Tolar, 2014; Stuebing, Fletcher, Branum-Martin, & Francis, 2012). However, it is important to understand that among the studies that have been conducted thus far, there are misrepresentations of PSW models, faulty assumptions about PSW models, and questions about the appropriateness of the methodology used to evaluate the assumptions underlying these models (see Flanagan & Schneider, 2016). Nevertheless, those engaged in PSW research should be commended for their work and for getting the conversation going. The current research has already sparked new ideas on how to evaluate the accuracy of the PSW approach more effectively (see Schneider's contribution in Flanagan, Alfonso, & Schneider, 2018; see also Miller et al., 2016).

Another emerging body of research provides support for a neuropsychological PSW approach (Hale et al., 2010, 2016). Specifically, this research shows the relevance of PSW methods for differential diagnosis of SLD in reading (e.g., Feifer, Nader, Flanagan, Fitzer, & Hicks, 2014), math (e.g., Kubas et al., 2014), and written expression (e.g., Fenwick et al., 2016). Valid points are made about the potential strengths of PSW models in this literature. Although valid points are made both for and against the use of PSW models, the results of the studies that have been published to date are affected by methodological preferences used to analyze the data, as well as the accuracy (and inaccuracy) of the assumptions made about each PSW model (for brief discussions, see Alfonso & Flanagan, 2018; Fiorello & Wycoff, Chapter 26, this volume; Flanagan & Schneider, 2016).

NOTES

1. Most individuals have statistically significant strengths and weaknesses in their cognitive ability and processing profiles. Intraindividual differences in cognitive abilities and processes are commonplace in the general population (McGrew & Knopik, 1996; Oakley, 2006). Therefore, statistically significant variation in cognitive and neuropsychological functioning in and of itself must not be used as de facto evidence of SLD. Instead, the pattern must reflect what is known about the nature of SLD (see Figure 22.2).

2. The term *causal* as used within the context of the DD/C model has been misconstrued to mean *deterministic*. That is, if we know the causal inputs, we can predict the outcome perfectly (Kranzler et al., 2016b). However, just because the causal inputs may be known, the outcomes clearly and obviously cannot be predicted perfectly. Cognitive abilities are indeed causally related to academic abilities, but the relationship is *probabilistic,* not deterministic, and is of moderate size (Flanagan & Schneider, 2016). The finding of cognitive weaknesses raises the risk of academic weaknesses; it does not guarantee academic weaknesses (Flanagan & Schneider), as assumed by Kranzler and colleagues. Likewise, it should not be assumed that the finding of academic weaknesses means that there are related cognitive weaknesses (again, a faulty assumption made by Kranzler et al.). As most practitioners know, in many cases there are no cognitive correlates to academic underachievement. This is because academic weaknesses may be related to numerous factors, only one of which is a cognitive weakness.

3. Many scholars use the term *overall cognitive/intellectual ability* interchangeably with the first factor that emerges in a factor analysis of cognitive tests—that is, Spearman's *g*. The estimates of overall cognitive or intellectual ability (or ability to think and reason) referred to in this chapter are consistent with this conceptualization.

4. Overall average (or better) cognitive ability or at least average ability to think and reason is difficult to

determine in students with SLD because their specific cognitive deficits often attenuate their total test scores (e.g., IQ). Therefore, such decisions should be based on multiple data sources and data-gathering methods. For example, a student with an SLD in mathematics may have a below-average WISC-V Full Scale IQ, due to deficits in processing speed and working memory (Flanagan & Alfonso, 2017; Geary et al., 2011). However, if the student has an average or better WISC-V GAI and average or better reading and writing ability, for example, then it is reasonable to assume that this student has at least average ability to think and reason. Of course, the more converging data sources that are available to support this conclusion, the more confidence one can place in such a judgment. The X-BASS calculates a value called the *facilitating cognitive composite (FCC)* that summarizes the individual's cognitive integrities or strengths when such a value is considered a good proxy of *g* given its constituents. The FCC is used in the PSW analysis conducted by X-BASS.

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