CHAPTER 4

Linking Assessment to Intervention

THE COGNITIVE HYPOTHESIS-TESTING MODEL

Prereferral Issues

In our cognitive hypothesis-testing (CHT) model, emphasis is placed on helping a majority of children through systematic prereferral services. As a psychologist, you must *intervene to assess*: You must develop an effective prereferral intervention program, using a team approach such as an intervention assistance team (see Ross, 1995) and problem-solving consultation, to reduce the number of referrals for formal evaluation. A large majority of children can be helped via an indirect service delivery model, and consultative approaches can effectively reduce the number of referrals for formal standardized evaluation. This is the only way in which the comprehensive CHT evaluations we argue for will be feasible; reducing referrals means gaining more time to conduct both interventions and more comprehensive evaluations.

Of course, there have been calls for more emphasis on prereferral interventions, or a move to interventions instead of referrals, for many years. Since Public Law 94-142 originally mandated serving children with disabilities rather than excluding them, school psychology has tried to emphasize interventions. The National Association of School Psychologists issued a volume titled *Alternative Educational Delivery Systems* (Graden, Zins, & Curtis, 1988), which called for more consultation, more teacher assistance teams, and more interventions. The 25th-anniversary issue of the *School Psychology Review* (Harrison, 1996) called for the same, as did *Best Practices in School Psychology IV* (Thomas & Grimes, 2002). Despite these numerous calls for professional change, however, school psychologists continue to spend the majority of their time in determining eligibility for special education (Hosp & Reschly, 2002). Why is this? There are probably several reasons. Intervention resources often depend on special education eligibility. Also, the funding to pay school psychologists may come from special education money. High student–psychologist ratios, as well as a high number of required assessments, may contribute to a lack of time to spend in alternative roles (e.g., Wilczynski, Mandal, & Fusilier, 2000). How can we increase the perceived value of interventions? In many schools, special education is seen as the only way to get help for a child who is experiencing difficulties. Systems change efforts must include resource allocation for supporting children in general education. Then the school psychologist's ability to help design and monitor those interventions will be seen as a valuable role, and the consultation role can increase. And when evaluations are truly useful for intervention design, rather than focusing entirely on eligibility, they will be valued as well. Only with a mix of both these roles can school psychologists completely fulfill the promise of their training.

As noted earlier, a child's behavior and his or her environment are inextricably related. The environment—including teachers, peers, the curriculum, and the classroom structure and routine—exerts a great influence on the child's behavior. But the child's characteristics—biological constraints, temperament, past learning history, and current skills—also influence both the child's behavior and, in turn, the environment. Practitioners can use information about *both* parts of the cycle to intervene and develop individualized interventions that will work with the environment to meet the child's unique needs. We suggest paying attention to both sides of the equation, since we feel that an exclusive focus either on external, environmental factors or on within-child factors neglects half the picture. This approach combines the two most powerful strands of the school psychology profession: individual psychoeducational assessment (e.g., Kamphaus, 2001; Sattler, 2001), and intervention development and monitoring from the behavioral intervention and problem-solving consultation models (e.g., Erchul & Martens, 2002; Thomas & Grimes, 2002).

CHT in Assessment and Intervention

Initially, standard problem-solving consultation is used in CHT to develop data-based interventions at the prereferral level. But a child who does not benefit from these initial interventions is referred for a formal CHT evaluation. The referral question, history, and previous interventions are examined to develop a theory of the problem (see #1 under "Theory" in Figure 4.1). If cognitive functioning is thought to be related to the academic or behavioral deficit areas in question (see #2 under "Hypothesis" in Figure 4.1), the intelligence/cognitive test is used as one of the first-level assessment tools (see #3 under "Data Collection/Analysis"). Via demands analysis, the findings are interpreted (see #4 under "Data Interpretation") to determine possible cognitive strengths and weaknesses (#5 under "Theory"). This is where many psychologists stop the process. Because of time demands, psychologists in the schools typically write their reports and pres-

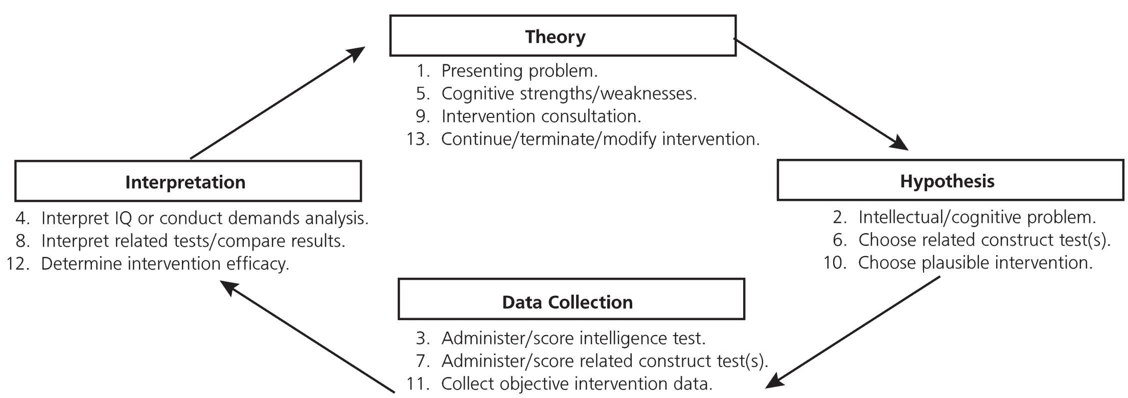

FIGURE 4.1. The cognitive hypothesis-testing (CHT) model.

ent their findings in a team meeting; they have little contact with the child, parents, or teacher thereafter (unless individual therapy is offered). But our CHT model goes beyond this to choose additional measures (#6 under "Hypothesis") to confirm or refute the intellectual test data (#7 under "Data Collection/Analysis"). The results are examined in light of the record review/history, systematic observations, behavior ratings, and parent/teacher interviews to gain a good understanding of the child (#8 under "Data Interpretation").

Completing the initial assessment is where the CHT process *begins*, not ends. Interventions are subsequently developed using the understanding of the child and the environment during collaborative consultative follow-up meetings with teachers and/or parents. Possible intervention strategies are explored in consultation with the teacher (#9 under "Theory"), and an intervention plan likely to succeed is developed (#10 under "Hypothesis"). The systematic intervention is then undertaken (#11 under "Data Collection/Analysis") and evaluated to determine intervention efficacy (#12 under "Data Interpretation"). If the intervention does not appear to be effective, it is revised or recycled until beneficial results are obtained (#13 under "Theory"). Like brief experimental analysis (Chafouleas, Riley-Tillman, & McGrath, 2002), the CHT model we describe uses a problem-solving approach and single-subject methodology to examine child performance over time. We are strong advocates for behavioral technology and single-subject methodology. The difference between our model and other behavioral approaches is that we use information about cognitive functioning in developing our interventions.

Conducting Demands Analysis

Demands analysis is a core component of the CHT model. It is the key both to accurate identification of childhood disorders and to development of interventions that are sensitive to individual needs. The demands analysis process that we present here is derived from two assessment traditions. The first tradition is the "intelligent testing" approach, which examines global, factor, and subtest scores based on clinical, psychometric, and quantitative research (e.g., Flanagan & Ortiz, 2001; Kamphaus, 2001; Kaufman, 1994; McGrew & Flanagan, 1998; Sattler, 2001). When formulating your clinical demands analysis, you must be careful to examine all relevant technical and cross-battery subtest information. Heavily influenced by the Luria (1973) approach to neuropsychological assessment, the second tradition consists of the developmental and process-oriented neuropsychological assessment approaches (e.g., Bernstein, 2000; Kaplan, 1988; Lezak, 1995). Although demands analysis may seem similar to other versions of profile analysis (e.g., Kaufman, 1994), the major difference is the emphasis on the neuropsychological and cognitive processes necessary for task completion. We have noted previously that the input and output demands are straightforward; they are the observable and measurable test stimuli and behavioral responses. However, research is clearly demonstrating that the underlying neuropsychological processing demands are essential for understanding and helping many children with their learning and behavior problems.

For many children and most tests/subtests, a brief demands analysis should be sufficient to examine and test hypotheses about brain–behavior relationships. We have provided you with two forms (Appendix 4.1 and Appendix 4.2) to guide you in interpretative efforts. The form in Appendix 4.2 may even be more helpful as you become more accustomed to demands analysis, because this allows you to add constructs as necessary to reflect the neuropsychological processes underlying a particular subtest or if a child responds in an idiosyncratic manner. To conduct the demands analysis, identify tests/subtests that represent the child's strengths and weaknesses. Enter them in the appropriate spaces in Appendix 4.2, and for each measure conduct a task analysis of the *input,* *processing*, and *output* demands. *Input* refers to the stimulus materials as well as the directions, demonstrations, and teaching items. Think about what modality or modalities are needed for the input—for example, whether there are pictures or verbal directions, whether the content is meaningful or abstract, and what other aspects of the content are relevant (e.g., level of English language used or amount of cultural knowledge required). *Processing* refers to the actual neuropsychological processing demands of the task, as discussed in Chapters 2 and 3. Think about the primary requirement (often suggested by the test's developers), but also secondary requirements, such as the executive and working memory skills needed to keep a stimulus in mind while processing it. *Output* refers to the modalities and skills required for responding to the task. Is the output a complex verbal response, a simple pointing response, or a complex motoric response? If oral expression is needed, is syntax important, and is word choice an issue? These are some of the questions you must answer in demands analysis. The form we provide in Appendix 4.1 is merely a tool for you to begin thinking about underlying psychological processes. We have included blanks in the last column for you to provide additional subtest input, processing, and output demands. Once you have listed the input, processing, and output demands for all of the child's strengths and weaknesses, it is important to look for commonalities and contradictions among the data.

After completing the sheets for each subtest, you attempt to identify patterns in the child's performance. If you find that one particular processing demand is required on all low-score tests, and it is not needed for the high-score tasks, you would hypothesize that this demand is a weakness for the child. Information from your observations of the child during testing, as well as information provided by the teacher, should also be consistent with any hypotheses. The weakness may be a cognitive processing weakness, but it may also be a sensory or motor weakness, a result of emotional interference, or a consequence of limited exposure or background. Enter this information on the worksheet provided in Appendix 4.3. Although these sheets and interpretive texts (e.g., Groth-Marnat, Gallagher, Hale, & Kaplan, 2000; Kamphaus, 1993; Kaufman, 1994; McGrew & Flanagan, 1998; Sattler, 2001) can be helpful in conducting demands analysis, you should not be lulled into a "cookbook" approach when interpreting subtest data—a tendency that often results in erroneous interpretation. To guard against this and to foster accurate interpretation, we have provided a checklist in Appendix 4.4. This checklist is primarily for you to complete to aid in clinical judgment, but it could possibly be used as an informant rating scale as well.

Let's walk through a demands analysis of the Wechsler Intelligence Scale for Children—Fourth Edition (WISC-IV) Block Design subtest to see what the process looks like. First, consider the input. The task has oral directions, and the task is modeled for younger children and those who have difficulty on the first item. The stimulus materials (booklet with visual model and two-color blocks) are abstract colored shapes, so that verbal encoding is difficult. The task will be novel for most children (although perhaps not on reevaluation or as the testing progresses). The processing demands are quite complex and involve both hemispheres and executive/frontal demands. Primarily, Block Design is a right-hemisphere task, since it is visual–spatial (i.e., involves the dorsal stream), is novel, and does not depend on crystallized prior knowledge. However, there is some bilateral processing because of the bimanual sensory and motor coordination, as well as the part (directional orientation of the blocks—left parietal) and whole (gestalt/spatial—right parietal) coordination (see Kaplan, 1988). There is a heavy frontal component, due to the executive and motor requirements of the task. The frontal demands include planning and organization, self-monitoring and evaluation of the response, inhibition of impulsive responding, and fine motor and bimanual coordination. This is particularly true if the child uses a trial-and-error approach. Note particularly if the child has more difficulty after the lines are removed from the stimulus book, as this may suggest right posterior (i.e. configuration problem) or frontal (delayed responding due to novelty) difficulties. Considering the output, Block Design requires fine motor and bilateral motor coordination, and adequate processing speed. Bilateral sensory–motor coordination requires the corpus callosum, so look for midline problems or a tendency to use just one hand. Slow responding may be due to difficulties in frontal–subcortical circuits (i.e., prefrontal–basal ganglia–cingulate) or the sensory–motor system (constructional praxis)—inattention/disorganization (symptoms resembling attention-deficit/hyperactivity disorder [ADHD]), low cortical tone or lethargy (motivation problems or depression-like symptoms), or perfectionistic tendencies (symptoms resembling obsessive–compulsive disorder [OCD] or other anxiety disorders).

Although conducting demands analysis may be helpful in understanding patterns of performance, remember that multifactorial tasks can be solved in more than one way, so that the demands analysis may differ from child to child. For instance, a child who uses good executive and psychomotor skills to compensate for a right posterior spatial problem may still do well on Block Design, but you would err if you concluded that the child had adequate visual–spatial–holistic processing skills. This is where we psychologists have often gone wrong in the past: concluding that the same subtest measures the same thing for all children. For instance, concluding that poor WISC-IV Information subtest performance is due to a limited "fund of information" may not be correct if a child has retrieval problems or difficulty due to limited knowledge in just one area, such as science. Concluding that a child has adequate attention, working memory, and executive function because he or she has an average WISC-IV Digit Span scaled score, but a Digits Forward score of 10 and a Digits Backward score of 2, would clearly be inappropriate (see Hale, Hoeppner, & Fiorello, 2002). Table 4.1 provides you with some sample demands analyses on a few additional subtests, so you can see how the process works. As you become more familiar with using demands analysis to task-analyze subtests you will eventually become quite comfortable with determining the demands on any subtest. In my (Hale's) graduate child neuropsychology assessment class, I have a final exam item that requires students to do a "mystery test" demands analysis on a test they have not been exposed to in class. Though students find this challenging, they typically find that they can identify the key input, processing, and output demands on the test. Try this activity yourself. Generalizing these skills to other measures will allow you to expand your use of demands analysis to just about any instrument you are trained to administer.

We now turn to a discussion of neuropsychological tests for use in the CHT model. Although many of these tests may be new to you, it is important to realize that the demands analyses you perform on cognitive and intellectual measures apply to neuropsychological measures as well. Do not let yourself be overly concerned that these measures are "neuropsychological"; many of them are easier to administer and score than the measures you are used to. For instance, the Stroop Color–Word Test requires approximately 5 minutes to administer (a stopwatch is needed to time 45 seconds for each subtest), and it has brief, simple instructions. Even though it is easy to administer, it is highly sensitive to executive functions and to frontal–subcortical circuit dysfunction.

ASSESSMENT TOOLS FOR CHT

Fixed versus Flexible Batteries in Hypothesis Testing

One of the biggest debates in neuropsychological assessment is whether to use a fixed test battery (a standard set of tests) or a flexible battery (a set of tests chosen for an individual child) (Bornstein, 1990). Fixed batteries predominated early in the field's history, but flexible batteries have become increasingly popular, especially since they tend to be more time- and cost-effective. Fixed batteries tend to lead to more testing than is needed to address unique child characteristics.

TABLE 4.1. Sample Demands Analysis of Selected Subtests

WISC-IV Block Design

Input

- Models and abstract visual pictures
- Oral directions—moderate English-language knowledge
- Demonstration/modeling
- Low cultural knowledge and emotional content

Processing

- Visual processing (spatial relations, visualization)
- Perception of part–whole relationships
- Discordant/divergent processing (analysis)
- Constructional praxis
- Bimanual coordination/corpus callosum
- Concordant/convergent processing (synthesis)
- Attention and executive demands: Moderate
- Planning and strategy use
- Inhibition of impulsive/wrong responding
- Novel problem solving: Low to moderate

Output

- Fine motor response, arrangement of manipulatives
- Timed score with speed bonus; process score without time bonus
- Visual–motor integration

SB5 Picture Absurdities (Levels 4, 5, and 6—Nonverbal Knowledge)

Input

- Large color pictures
- Oral directions
- Sample item
- High cultural and English-language knowledge

Processing

- Visual scanning
- Perception of objects (ventral stream)
- Crystallized ability for prior knowledge (left temporal)
- Discordant/divergent processing (analysis)
- Attention and executive demands: Low to moderate
- Persistence/inhibition of impulsive responding
- Novel problem solving/reasoning

Output

- Brief oral or pointing response
- One right answer (convergent responding)

WJ-III Visual–Auditory Learning

Input

- Brief oral directions, teaching items, feedback
- Semiabstract figures/symbols
- Moderate cultural and English-language knowledge

(continued)

TABLE 4.1. *(continued)*

WJ-III Visual–Auditory Learning *(continued)*

Processing

- Visual perception of figures/symbols (dorsal and ventral streams)
- Sound–word/symbol–rebus association
- Working memory/learning
- Encoding and retrieval of associative/semantic memory
- Benefiting from feedback
- Inhibition of impulsive/wrong responding
- Syntax knowledge: Helpful
- Attention and executive demands: Moderate to high
- Memory: primary; novel problem solving: secondary

Output

- Brief oral response
- Oral formulation/retrieval

CAS Nonverbal Matrices

Input

- Brief oral directions; sample and teaching items
- Abstract/nonmeaningful figures
- Low cultural knowledge and English-language knowledge

Processing

- Visual scanning and discrimination
- Color processing
- Visual–spatial processing (dorsal stream)
- Part–whole relationships
- Discordant/divergent processing (perceptual analysis)
- Novel problem solving and inductive reasoning/fluid abilities
- Attention and executive demands: Moderate
- Inhibition of impulsive/wrong responding

Output

- Pointing response
- Multiple-choice format (can solve by elimination/match to sample)

In addition, a fixed battery gives examiners the impression that the battery assesses all relevant neuropsychological domains (Lezak, 1995). We too prefer a flexible-battery approach in the CHT model, because different measures and techniques can be used to address hypotheses developed after initial data gathering. You may need one or more measures that look at a particular domain in depth. For instance, if you're interested in an apparent visual–sensory–motor integration deficit, you really need to pick and choose measures that tap each of these four possible causes to get a better understanding of the problem and direction for intervention.

This is not to say that a fixed-battery approach should be completely avoided. Some neuropsychologists prefer such approaches, because all the children tested are administered the same tests in the same order. This can serve both research and practice needs. Obviously, many children who receive the same measures would be needed for a group-design research project. For clinicians, fixed-battery approaches not only help standardize performance expectations across children, but also allow practitioners an opportunity to develop "head norms" about child performance. It is much easier to interpret a measure after dozens of regular administrations than if it is used sparingly to test hypotheses for individual children. In addition, once demands analyses have been done on the fixed-battery subtests, they may only need to be changed slightly for children who perform them in a unique way. Finally, the use of a fixed battery does not preclude additional hypothesis testing with other instruments. Actually, using an intellectual/cognitive measure (e.g., the Woodcock–Johnson III [WJ-III]), a fixed battery (e.g., the Halstead–Reitan), and additional hypothesis-testing measures (e.g., subtests from the Comprehensive Test of Phonological Processing [CTOPP]) might be the ultimate approach for conducting CHT. However, it is important to remember that as the number of measures increases, the likelihood of child performance variability and of Type I error increases as well.

Intellectual Tests for Hypothesis Testing

You may be surprised to find that you are already familiar with many of the tools available for CHT—including the intelligence/cognitive tests discussed in Chapter 1, such as the subtests found on the Differential Ability Scales (DAS), Stanford–Binet Intelligence Scale: Fifth Edition (SB5), WISC-IV, and WJ-III. Although intelligence test subtests are typically factorially complex (McGrew & Flanagan, 1998), there is often a wealth of information published about these measures; their technical quality can be thoroughly evaluated; and you are familiar with their scoring and interpretation. The manuals on these measures come with many statistics to support interpretation, such as reliability, standard deviations, standard error of measurement, correlations, factor analyses, and validity studies.

To aid in your demands analysis of these and other measures, it is worthwhile to consult *The Intelligence Test Desk Reference* (McGrew & Flanagan, 1998), which specifies subtest technical characteristics from a *Gf-Gc* cross-battery approach perspective, and Sattler's (2001) *Assessment of Children: Cognitive Applications* text. Similarly, CHT of the skills necessary for academic performance can utilize subtests from several achievement batteries. For instance, on the WJ-III Tests of Achievement, the Story Recall subtest can be used to assess long-term memory encoding and retrieval of semantic information in addition to receptive and expressive language. Another valuable text for use in CHT is *The Achievement Test Desk Reference* (Flanagan, Ortiz, Alfonso, & Mascolo, 2002) which provides readers with technical information and guidance in administering and interpreting many achievement measures.

Although these intellectual and achievement instruments are useful in CHT, let us now examine several test batteries that are often considered "neuropsychological" instruments. It is important to realize that many neuropsychological tests are easy to administer and score, and that they tap many of the constructs already discussed in this book. We do not claim to present an exhaustive list of measures, just those that we have found to be useful in our practice of CHT. We do not suggest that these measures are better than others, or that measures not included here cannot be adopted in the CHT model. However, recall that it is your responsibility to evaluate whether a measure has adequate technical quality for use in CHT. In addition, you should complete a demands analysis for each measure you use and review the extant literature on new tests before you use them. Do not automatically assume that a test measures what we suggest, or what the test authors report in the manual. Although our interpretive information is limited, you can consult the test manuals and other interpretive texts to aid in your understanding of the measures (e.g., Groth-Marnat, 2000b; Golden, Espe-Pfeifer, & Wachsler-Felder, 2000; Reynolds & Fletcher-Janzen, 1997; Spreen & Strauss, 1998). Your background, training, and experience will determine your need for individual training and supervision on these measures.

Traditional Neuropsychological Test Batteries

We begin our review of instruments by discussing two of the most commonly used neuropsychological test batteries (NTBs): the Halstead–Reitan NTB (Reitan & Wolfson, 1993) and the Luria–Nebraska NTB (Golden, Purisch, & Hammeke, 1985). Though we aren't advocating that every school psychologist use one of these batteries, a brief description follows to familiarize you with them. These batteries are often used as "fixed" batteries, and both have a long tradition of use in neuropsychological assessment and research, so there are many supplemental resources and publications to aid in their interpretation.

Halstead–Reitan NTB

Table 4.2 provides an overview of the constructs tapped by the Halstead–Reitan NTB (Reitan & Wolfson, 1993) subtests, and of possible brain areas responsible for performance. The Category Test requires the child to view simple objects on a screen and press a button coinciding with the numbers 1 to 4. The child is not told how to perform the task, but instead receives feedback after each response. (A more recent version of the Category Test is mentioned later in Table 4.10.) For the Tactile Performance Test, the child is blindfolded and presented with an upright formboard and shapes. The child places the different shapes in the corresponding holes as quickly as possible, first with the dominant hand, then with the nondominant hand, and then with both. The Trail Making Test is a connect-the-dots task, where the child draws a line connecting numbers in order (Trails A), and then alternating between numbers and letters (Trails B), as quickly as possible. For the Sensory-Perceptual Examination, a brief screening of visual, auditory, and somatosensory functioning is followed by three somatosensory tasks: finger touching, writing of numbers (older children) or symbols (young children) on fingers/hands, and recognition of shapes, all hidden from the child's view. The Finger Tapping test is a simple measure of motor speed and persistence. The Halstead–Reitan provides an Impairment Index of brain dysfunction/damage, which ranges from 0 to 10. Although the original norms may have been limited, more recent normative data and in-

TABLE 4.2. Characteristics of Halstead–Reitan Neuropsychological Test Battery (NTB) Subtests

Subtest	Constructs purportedly tapped	Brain areas involved
Category Test	Concept formation, fluid reasoning, learning skills, mental efficiency	Prefrontal area, cingulate, hippocampus, temporal lobes (?) (associative and categorical thinking)
Tactile Performance Test	Tactile sensitivity, manual dexterity, kinesthetic functions, bimanual coordination, spatial memory, incidental learning	Lateralized sensory and motor areas, parietal lobes, corpus callosum, hippocampus
Sensory-Perceptual Examination	Simple and complex sensory functions	Lateralized sensory areas (more complex, bilateral?)
Finger Tapping	Simple motor speed	Lateralized motor areas
Trail Making Test, Parts A and B (Trails A and B)	Processing speed, graphomotor coordination, sequencing, number/letter facility (Trails B also requires working memory, mental flexibility, set shifting)	Trails A: Dorsal stream, premotor area, primary motor area, corpus callosum; Trails B: also prefrontal–basal ganglia–cingulate

terpretive strategies have been developed. For a recent review of the Halstead–Reitan NTB, see Nussbaum and Bigler (1997).

Luria–Nebraska NTB

The Luria–Nebraska NTB (Golden et al., 1985) consists of 12 scales derived from Luria's (1973, 1980a, 1980b) approach to neuropsychological assessment, which emphasizes flexible administration and interpretation of measures. Therefore, it is not a true fixed battery per se, but practitioners may have a tendency to administer it as such. The 12 Luria–Nebraska subscales are labeled Motor, Rhythm, Tactile, Visual, Receptive Language, Expressive Language, Writing, Reading, Arithmetic, Memory, Intelligence, and Delayed Memory. Because the traditional examination may take up to 2 days to complete (Golden, Freshwater, & Vayalakkara, 2001), this instrument may not be practical for use in the schools. As we will see in the next section, several contemporary neuropsychological assessment tools are available to assess skills similar to those tapped by the Luria–Nebraska domains, and many were designed solely for use with children. For a recent review of the Luria–Nebraska NTB, see Golden (1997).

Neuropsychological/Cognitive Tests for Hypothesis Testing

We now review instruments that assess multiple as well as specific areas of neuropsychological functioning. You may wish to use an entire test at times, but for the most part, you will pick and choose subtests from these batteries for CHT. They are listed in alphabetical order.

Children's Memory Scale

Since we are often asked to give an indication of a child's capability of learning in the classroom, it is somewhat surprising that more educational administrators don't mandate assessment of learning and memory skills. Designed for use with children aged 5–16, the Children's Memory Scale (CMS; Cohen, 1997) is an excellent measure of learning and memory designed for clinical assessment. It was carefully standardized on a representative sample. It is not surprising that the CMS demonstrates adequate internal consistency for a memory measure, and comprehensive validity studies support the instrument's construct validity. It has six core subtests, two each in the Auditory/Verbal, Visual/Nonverbal, and Attention/Concentration domains; the last domain is probably the least useful in CHT. In addition, there are three supplemental subtests, one for each domain. The subtests we typically use are presented in Table 4.3. The reported subtests all have delayed portions for further examination of long-term memory retrieval—an advantage of this measure. A disadvantage is relying on the Auditory/Verbal–Visual/Nonverbal dichotomy for organizing the battery.

Cognitive Assessment System

Designed for ages 5–17, the Cognitive Assessment System (CAS; Naglieri & Das, 1997) is a relatively new measure of cognitive functioning that represents the authors' planning, attention, simultaneous, and successive (PASS) model (Das, Naglieri, & Kirby, 1994). It is purportedly based on Luria's model of neuropsychological processing and assessment, but as we have seen in Chapter 2, there is no PASS acronym in Luria's model. In addition, although the authors' confirmatory

TABLE 4.3. Characteristics of Children's Memory Scale (CMS) Subtests

Subtest	Constructs purportedly tapped
Auditory/Verbal	
Stories	Auditory attention, semantic long-term memory encoding and retrieval, sequencing/ grammar, verbal comprehension, expressive language
Word Pairs	Paired-associate task; auditory attention, learning novel word pairs
Word Lists	Selective reminding task; long-term memory encoding, storage, and retrieval of unrelated words
Visual/Nonverbal	
Dot Locations	Visual–spatial memory encoding and retrieval (dorsal stream), susceptibility to interference
Faces	Visual–facial memory encoding and retrieval (ventral stream)
Attention/Concentration	
Sequences	Rote recall of simple information followed by mental manipulation/executive function items

factor analysis has been used to support a four-factor model, cross-battery analyses have raised doubt about the model, with findings suggesting that the Planning and Attention factors should be combined (Carroll, 1995; Keith, Kranzler, & Flanagan, 2001; Kranzler & Keith, 1999). This would certainly fit with Luria's (1973) model, as attention and executive functions are intimately related to the integrity of the third functional unit or frontal lobes (except for cortical tone, which would be the responsibility of Luria's first functional unit). Of course, for an individual child, planning and attention may differ and lead to different recommendations, so their separation may be relevant for individual children.

Another issue has to do with purported relationships between the hemispheres and CAS measures. Whereas the association between simultaneous processes and right-hemisphere functions makes sense, the association of the left hemisphere with successive processes needs further examination. As we have seen in Chapters 2 and 3, this representation is not entirely correct—leaving the construct validity of the PASS model in question, at least as a neuropsychological test. Two of the successive tasks rely heavily on grammatical structure, and all use verbal information, so they are not truly tests of successive processing. It is interesting to note that the test authors' own predictive validity study, using the WISC-III, CAS, and WJ-R achievement scores, revealed that the WISC-III Verbal scale consistently predicted achievement domains better than the CAS factors.

Given these criticisms, why do we advocate use of the CAS in CHT? We like to use several of the CAS subtests for hypothesis testing. The scale was adequately normed, and most subtests show good technical characteristics. In addition, the test authors have provided us with the first substantial treatment validity studies of any cognitive measure, presented in the PASS Remedial Program (PREP; see Das, Carlson, Davidson, & Longe, 1997). The PREP has focused primarily on reading, with training of successive and simultaneous skills leading to improved word recognition and decoding skills. There is also evidence that strategy-based instruction can improve math achievement in students with poor planning skills. We do not think, however, that the CAS should be used to measure global intellectual functioning, even though it provides a Full Scale standard score (SS). Absent from the CAS, moreover, is a measure of crystallized intelligence (*Gc*). Although the lack of *Gc* measurement makes the CAS a fair test for people for people of linguistic and cultural difference, it doesn't adequately tap left-hemisphere processes as a result. Therefore, though we feel that the CAS is not adequate as a baseline measure of global functioning, it is a good tool for hypothesis testing. Given these caveats and criticisms, we present the CAS subtests we typically administer in Table 4.4. Please note that our interpretation is somewhat different from that presented by the test authors.

Comprehensive Test of Phonological Processing

The CTOPP (Wagner, Torgesen, & Rashotte, 1999) is a unique measure of the cognitive constructs most commonly associated with reading and language disorders. Designed for use with children and youth aged 5–24, it measures phonological awareness, phonological memory, and rapid automatized naming, which have been linked with word recognition, word attack, and other basic reading skills (Wolf, 2001). The CTOPP is composed of 13 subtests, several of which we find useful in CHT. It was recently normed on a fairly large representative sample, and subtests have good to excellent good technical characteristics. Validity studies show the phonological awareness and rapid naming tasks have strong relationships with reading skills.

TABLE 4.4. Characteristics of Cognitive Assessment System (CAS) Subtests

Subtest	Constructs purportedly tapped
Planning	
Matching Numbers	Sustained attention, visual scanning, psychomotor speed
Planned Connections	Substitute for Halstead–Reitan Trails A and B (see Table 4.2), but no separation
Attention	
Expressive Attention	Substitute for Stroop Color–Word Test (see Table 4.10); inhibition of automatic response (reading words) to name ink color of printed word
Number Detection	Cancellation task; sustained attention, visual scanning, visual discrimination, inhibition, psychomotor speed
Simultaneous Processing	
Nonverbal Matrices	Typical *Gf* measure of inductive reasoning; multiple-choice format
Verbal/Spatial Relations	Similar to Token Test for Children (see Table 4.10); receptive language, verbal working memory, grammatical relationships, visual scanning/discrimination
Figural Memory	Similar to DAS Recall of Designs (see Chapter 1, Table 1.1); visual perception, spatial relationships, visual memory, graphomotor reproduction, constructional skills, figure–ground relationships (?)
Successive Processing	
Word Series	Word span; rote recall of unrelated words
Sentence Repetition	Rote recall of meaningless sentences; grammatical structure important
Sentence Questions	Similar sentence stimuli to Sentence Repetition, but child answers questions (e.g., "The brown is purple. What is purple?" Answer: "The brown.")

Table 4.5 outlines the CTOPP subtests and what they measure. The Nonword Repetition subtest is an interesting task that taps phonemic processing and expression skills for nonsense words (e.g., "lidsca"), similar to other visually presented pseudoword tasks. However, it includes an auditory model (so the child hears the nonword first) and an auditory working memory component (because the child has to recall what he or she heard). This task can be combined with the Blending Nonwords (e.g., "raq" + "di") subtest to help determine whether the phonological breakdown is occurring at the individual-phoneme level or the assembly level. An additional concern with the CTOPP is the limited assessment of rapid naming. Including rapid naming of more complex letter combinations (e.g., digraphs, diphthongs) and simple words presented two grades below reading level would have been helpful. Although phonological processes have been linked to left temporal lobe functions, and rapid naming is typically associated with frontal structures, you should recognize that several areas are involved in reading competency, as discussed in Chapters 2 and 5.

Delis–Kaplan Executive Function System

The Delis–Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) is a measure of key components of executive function, mediated primarily by the frontal lobe. It was recently developed and normed on a large representative national sample to assess ages 8–89. Unlike many neuropsychological measures, the D-KEFS has extensive information about technical quality presented in the manual, which facilitates interpretation. Any of the specific tests can be administered separately, making it ideal for use in CHT. Many of the tasks have rich histories in neuropsychological assessment, and research is likely to support the validity of these measures. Table 4.6 describes the individual D-KEFS tests and the constructs purportedly assessed by each.

Kaufman Adolescent and Adult Intelligence Test

Although the Kaufman Adolescent and Adult Intelligence Test (KAAIT; Kaufman & Kaufman, 1993) provides good measures for hypothesis testing of *Gc* and fluid intelligence (*Gf*), it is pri-

TABLE 4.5. Characteristics of Comprehensive Test of Phonological Processing (CTOPP) Subtests

Subtest	Constructs purportedly tapped
Phonological Awareness	
Elision	Phonological perception, segmentation, individual phonemes
Blending Words	Phonological assembly; similar to WJ-III Sound Blending (see Chapter 1, Table 1.4)
Phonological Memory	
Nonword Repetition	Phonemic analysis, assembly, auditory working memory
Rapid Naming	
Rapid Object Naming	Object recognition, naming automaticity, processing speed, verbal fluency
Rapid Digit Naming	Number automaticity, processing speed, verbal fluency
Rapid Letter Naming	Letter automaticity, processing speed, verbal fluency

TABLE 4.6. Characteristics of Delis–Kaplan Executive Function System (D-KEFS) Subtests

Subtest	Constructs purportedly tapped
Sorting Test	Problem solving, verbal and spatial concept formation, categorical thinking, flexibility of thinking on a conceptual task
Trail Making Test	Mental flexibility, sequential processing on a visual–motor task, set shifting
Verbal Fluency Test	Verbal fluency
Design Fluency Test	Visual fluency
Color–Word Interference Test	Attention and response inhibition
Tower Test	Planning, flexibility, organization, spatial reasoning, inhibition
20 Questions Test	Hypothesis testing, verbal and spatial abstract thinking, inhibition
Word Context Test	Deductive reasoning, verbal abstract thinking
Proverb Test	Metaphorical thinking, generating versus comprehending abstract thoughts

marily designed for children 11 years of age and older, so this limits its use in CHT to older children. For *Gc*, the Word Knowledge subtest is a measure of word knowledge and verbal concept formation; Auditory Comprehension taps understanding of oral information; and Double Meanings measures categorical responding (i.e., the child must determine the word that best fits two different meanings). For *Gf*, the Rebus Learning subtest is similar to the WJ-III *Glr* task; Logical Steps taps logical reasoning and problem solving; and Mystery Codes requires detecting relationships and applying them to solve novel problems. It also has four extended-battery subtests: Famous Faces, Memory for Block Designs, Rebus Delayed Recall, and Auditory Delayed Recall. Although the KAAIT cannot be used for younger children, it is easy to administer and score, and has fairly good technical characteristics (Sattler, 2001). Consider using this battery in CHT if you work with older children, as we feel it is a much more theoretically sound instrument than the Kaufman Assessment Battery for Children (Kaufman & Kaufman, 1983), which suffers from the same problem as the CAS (the simultaneous/right-hemisphere–successive/left-hemisphere dichotomy).

NEPSY

The NEPSY (Korkman, Kirk, & Kemp, 1998) is the first *truly* developmental neuropsychological measure designed for children aged 3–12. There are 27 subtests designed to provide a comprehensive evaluation of five functional domains: Attention/Executive Functions, Language, Sensorimotor Functions, Visuospatial Processing, and Memory and Learning. The NEPSY subtests and flexible administration format are primarily based on Luria's (1973, 1980a, 1980b) model. However, like similar measures, the test does not break tasks down into primary, secondary, or tertiary skills; nor does the manual readily identify the relationships between subtest performance and the first, second, and third functional units. With many years in development, the NEPSY has all the advantages of being published by a major test developer, including an adequate normative sample, subtest technical quality, and ample validity studies. Not all of the NEPSY subtests show comparable technical quality, however, so Table 4.7 presents the subtests we have found to be most beneficial in CHT. In addition, though the Language subtests serve as a measure of *Gc*, the NEPSY does not adequately measure *Gf* or novel problem-solving skills.

TABLE 4.7. Characteristics of NEPSY Subtests

Subtest	Constructs purportedly tapped
Attention/Executive Functions	
Tower	Planning, inhibition, problem solving, monitoring, and self-regulation
Auditory Attention and Response Set	Sustained auditory attention, vigilance, inhibition, set maintenance, mental flexibility
Visual Attention	Visual scanning, self-organization, processing speed
Design Fluency	Visual–motor fluency, mental flexibility, graphomotor responding in structured and unstructured situations
Language	
Phonological Processing	Similar to WJ-III *Ga* subtests (see Chapter 1, Table 1.4); auditory attention, phonological awareness, segmentation, assembly
Comprehension of Instructions	Similar to token test for Children (see Table 4.10); receptive language, sequencing, grammar, simple motor response
Repetition of Nonsense Words	Auditory presentation of nonsense words; phonemic awareness, segmentation, assembly, sequencing, simple oral expression
Verbal Fluency	Similar to Controlled Oral Word Association Test (see Table 4.10); rapid long-term memory retrieval in structured (semantic cue) and unstructured (phonemic cue) situations
Sensorimotor Functions	
Fingertip Tapping	Simple motor speed, perseverance
Imitating Hand Positions	Visual perception, memory, kinesthesis, praxis
Visuomotor Precision	Visual–motor integration, graphomotor coordination without constructional requirements
Finger Discrimination	Simple somatosensory perception, finger agnosia
Visuospatial Processing	
Design Copying	Visual perception of abstract stimuli, visual–motor integration, graphomotor skills
Arrows	Spatial processing, visualization, line orientation, inhibition, no graphomotor demands
Block Construction	Similar to WISC-III Block Design (see Tables 1.3 and 4.1)

Process Assessment of the Learner: Test Battery for Reading and Writing

To look in more detail at the processes involved in reading and writing, the Process Assessment of the Learner: Test Battery for Reading and Writing (PAL; Berninger, 2001) is available to complement regular standardized achievement testing. Individual subtests can be administered and interpreted, making this test ideal for CHT. There are also intervention materials available for both individual and classroom implementation. The PAL includes measures of phonological processing; orthographic coding; rapid automatized naming; and integration of listening, note taking, and summary writing skills. Although the PAL is used for examining academic skills, it focuses on processes associated with these skills, making it especially useful for linking assessment to intervention.

Test of Memory and Learning

The Test of Memory and Learning (TOMAL; Reynolds & Bigler, 1994) is in many ways a more comprehensive measure of learning and memory than the CMS. Designed for children aged 5–19, the TOMAL consists of 10 core and 4 supplemental subtests, and 4 delayed-recall subtests. It was carefully standardized, and the norms are representative of the 1990 U.S. census population. Reliabilities tend to be quite strong across ages, especially for the composite scores. Unfortunately, the validity studies are not as comprehensive as those for the CMS. However, further support for its use in memory assessment can been found in subsequent studies reported in the literature. Table 4.8 provides an overview of the TOMAL subtests we find useful in CHT. The Delayed Recall Index includes delayed recall from the Memory for Stories, Word Selective Reminding, Facial Memory, and Visual Selective Reminding subtests. As with the CMS, one of the difficulties with the TOMAL is its breakdown into verbal and nonverbal memory domains.

Wide Range Assessment of Memory and Learning

The Wide Range Assessment of Memory and Learning (WRAML; Sheslow & Adams, 1990) was the first child memory scale on the market, having been developed in the 1980s. Like the other measures reviewed here, it examines verbal and visual memory, and includes a learning index score. Additional examination of delayed recall is possible. For verbal memory, rote, sentence, and story memory are tapped. For visual memory, both abstract and meaningful memory are assessed, and visual–sequential memory is assessed via an interesting Finger Windows subtest, which is difficult to mediate with verbal skills. There are also a list-learning task, a memory-for-designs task (in which the child tries to find matching designs), and a sound–symbol association task. These tasks are challenging yet interesting for children, making the WRAML a possible alternative to the CMS and TOMAL. It is fairly easy to administer and score. It has a large normative sample

TABLE 4.8. Characteristics of Test of Memory and Learning (TOMAL) Subtests

Subtest	Constructs purportedly tapped
Verbal Memory Index	
Memory for Stories	See CMS Stories (Table 4.3 lists this and other CMS subtests)
Word Selective Reminding	Similar to CMS Word Lists, but no interference task
Paired Recall	See CMS Word Pairs
Digits Backward	Similar to WISC-III/WJ-III versions; more demands on attention, working memory, executive functions
Nonverbal Memory Index	
Facial Memory	See CMS Faces; good ventral stream measure
Visual Selective Reminding	Visual analogue to word selective reminding, with dots; dorsal stream, visual–motor coordination, praxis without visual discrimination
Abstract Visual Memory	Visual discrimination of abstract symbols, recognition memory
Visual–Sequential Memory	Visual discrimination of abstract symbols, sequencing, praxis
Memory for Location	See CMS Dot Locations; good dorsal stream measure
Manual Imitation	Short-term visual–sequential memory, praxis

and adequate technical characteristics. However, some have questioned the construct validity and structure of the test (for a review, see Spreen & Strauss, 1998).

WISC-IV Integrated/WISC-III Processing Instrument

We conclude this section with the unique WISC-IV Integrated and its predecessor, the WISC-III Processing Instrument (WISC-III PI; Kaplan, Fein, Kramer, Delis, & Morris, 1999). These instruments are unique because they help examiners test the limits and derive both qualitative and quantitative data for interpretive purposes. Designed to objectify many of the qualitative neuropsychological interpretation methods posited by Kaplan and colleagues in their Boston process approach (see Chapter 3), these measures are easily incorporated into your assessments, especially if you use the WISC-III or WISC-IV as your initial intellectual assessment tool. Because the WISC-IV and WISC-III subtests are factorially complex, tapping several cognitive processes, further evaluation is often needed to pinpoint individual strengths and weaknesses. Designed primarily for children aged 8–16, the WISC-IV Integrated and WISC-III PI have additional measures and procedures for hypothesis testing, so it may be helpful to administer only the sections that are relevant to the areas of concern (Sattler, 2001). Some procedures are administered during the WISC-IV or WISC-III, while others are administered immediately following the assessment. Several of the WISC-IV Integrated/WISC-III PI procedures are designed to provide a more comprehensive way to look at scoring WISC-IV/WISC-III responses, while several other stand alone subtests can aid in CHT. Although some reliabilities are low and more validity information would be helpful, the WISC-IV Integrated and WISC-III PI have satisfactory concurrent validity, and they are unique instruments for obtaining qualitative and quantitative information about a child's cognitive functioning (Sattler, 2001). An overview of the WISC-IV Integrated/WISC-III PI measures and procedures we prefer, and the constructs purportedly measured by each, are presented in Table 4.9.

Supplemental Neuropsychological Measures for Hypothesis Testing

Table 4.10 presents a number of other neuropsychological measures we have found useful in CHT. Although some are specifically for use with children, others listed in this table have a long history of use in neuropsychological assessment of adults, and most have been adequately extended downward for use with children. These instruments measure a variety of cognitive or neuropsychological constructs, and many have been found to be sensitive to brain functions and dysfunctions. They can be used to test initial hypotheses or validate hypotheses derived from previously discussed measures. Some measures, such as the Rey–Osterreith Complex Figure (a visual–spatial–graphomotor task) and the California Verbal Learning Test (a language task), could be listed under other table subheadings. However, we have put the measures in the domains that are most likely to serve our CHT purposes.

BEHAVIORAL NEUROPSYCHOLOGY AND PROBLEM-SOLVING CONSULTATION

Utilizing Assessment and Consultation Skills

Now that we have reviewed the assessment part of our model, let's integrate it with consultation technology. Notice the heading above. Isn't *behavioral neuropsychology* an oxymoron? No, because we believe that these two technologies should become one, not be seen as antithetical. Con-

TABLE 4.9. Characteristics of WISC-III Process Instrument (WISC-III PI) Subtests and Procedures

Subtest	Constructs purportedly tapped
Verbal scale/Verbal Comprehension and Working Memory Indices	
1. Information Multiple Choice 2. Vocabulary Multiple Choice (WISC-IV Integrated also includes Similarities and Comprehension Multiple Choice)	Long-term memory retrieval of prior learning (1) and word knowledge (2); compares free-recall and recognition memory
Picture Vocabulary	Taps receptive word knowledge for comparison with expressive word knowledge in #2 above
1. Arithmetic Addendum 2. Written Arithmetic	1. Mental problem solving of items read simultaneously with examiner; paper/pencil for failed items; reduces attention/executive/working memory demands, and eliminates auditory processing requirements 2. Presents equations on paper; helps determine math skills in absence of Arithmetic processing demands
Sentence Arrangement (WISC-III PI)	Verbal analogue to WISC-III Picture Arrangement; semantic/grammatical knowledge and sequencing, but not temporal relationships
Digit Span Forward/Backward	Separates rote auditory memory (Forward) from attention, working memory, and executive functions (Backward)
1. Letter Span Rhyming and Non-Rhyming 2. Letter Number Sequencing—Embedded Words	1. Letters of sequence rhyme or do not rhyme, with the former resulting in phonological/auditory processing demands, reducing rote aspect of encoding and retrieval 2. Letters form words, which helps encoding, but working memory still relevant; may be more difficult breaking known word into alphabetical order
Performance scale/Perceptual Reasoning and Processing Speed Indices	
1. Block Design PI 2. Block Design Multiple Choice	1. Part A (Unstructured): six additional designs; Part B (Structured): failed Part A designs; helps determine configuration (right-hemisphere) vs. orientation (left-hemisphere) errors 2. Visual discrimination, spatial perception; removes visual–motor integration and processing speed demands
1. Visual Span Forward/Backward 2. Spatial Span Forward/Backward	Visual–spatial analogues to digit span forward/backward; with Digit Span, can compare auditory with visual sensory and working memory, sequencing, mental flexibility, and ability to shift cognitive sets 1. Visual attention, numeric memory, and verbal response 2. Spatial–holistic or visual–sequential memory, praxis
1. Coding Incidental Learning Recall 2. Coding–Symbol Copy	1. Paired-associate symbol recall, free recall, paired-associate digit recall (visual memory and graphomotor reproduction of symbols and numbers, retrieval of number–symbol associations) 2. Visual–motor integration, graphomotor skills, and processing speed
Symbol Search	Child marks matching symbol in array or no box; ensures "guessing" is not occurring; better measure of discrimination and sustained attention
Elithorn Mazes	Maze-like task; assesses executive functions such as planning, organization, monitoring, working memory, and inhibition better than WISC-III Mazes, still requires graphomotor skills

TABLE 4.10. Supplemental Measures for Hypothesis Testing

Subtest	Constructs purportedly tapped
Attention/memory/executive function	
Children's Category Test (Boll, 1993)	See Halstead–Reitan Category Test (Table 4.2)
Wisconsin Card Sorting Test (Heaton, Chellune, Talley, Kay, & Curtis, 1993)	Executive functions, problem solving, set maintenance, goal-oriented behavior, inhibition, ability to benefit from feedback, mental flexibility, perseveration
Tower of London (Shallice, 1982)	See NEPSY Tower (Table 4.7)
Stroop Color–Word Test (Golden, 1978)	See CAS Expressive Attention (Table 4.4)
Rey–Osterrieth Complex Figure (Meyers & Meyers, 1995)	Visual–motor integration, constructional skills, graphomotor skills, visual memory, planning, organization, problem solving
Conners Continuous Performance Test II (CPT; Conners & MHS Staff, 2000)	Computerized measure of sustained attention, impulse control, reaction time, persistence, response variability, perseveration, visual discrimination
Gordon Diagnostic System (Gordon, 1991)	Similar to Conners Test (see above) for vigilance task; delay task includes problem solving, learning temporal relationships, impulse control, self-monitoring, ability to benefit from feedback
California Verbal Learning Test—Children's Version (Delis, Kramer, Kaplan, & Ober, 1994)	Verbal learning, long-term memory encoding and retrieval, susceptibility to interference
Comprehensive Trail-Making Test (CTMT; Reynolds, 2002)	Attention, concentration, resistance to distraction, cognitive flexibility/set shifting
Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith,Guy, & Kenworthy, 2000)	Parent and teacher rating scales of behavioral regulation, metacognition; includes clinical scales assessing inhibition, cognitive shift, emotional control, task initiation, working memory, planning, organization of materials, and self-monitoring; includes validity scales assessing inconsistent responding and negativity
Sensory–motor/nonverbal skills	
Developmental Test of Visual–Motor Integration (Beery, 1997)	Visual-perceptual skills, fine motor skills, visual–motor integration
Grooved Pegboard (Kløve, 1963)	Complex visual–motor–tactile integration, psychomotor speed (compare to simple sensory–motor integration)
Judgment of Line Orientation (Benton & Tranel, 1993)	See NEPSY Arrows (Table 4.7)
Language measures	
Oral and Written Language Scales (Carrow-Woolfolk, 1996)	Listening comprehension, oral expression, written expression; not limited to single-word responses, as the PPVT-III and EVT (see below) are
Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999)	Language processing in comprehension, expression, and retrieval in these categories: lexical/semantic, syntactic, supralinguistic, pragmatic; the supralinguistic and pragmatic categories show promise in the assessment of right-hemisphere language skills

(continued)

TABLE 4.10. *(continued)*

Subtest	Constructs purportedly tapped
Language measures *(continued)*	
Clinical Evaluation of Language Fundamentals—Fourth Edition (CELF-4; Semel, Wiig, & Secord, 2003)	Assesses receptive and expressive language with the core subtests, but also allows assessment of language structure, language content, and memory; includes standardized observations in the classroom and assessment of pragmatic language skills, in addition to individual assessment
Test of Language Development—TOLD-3, Primary and Intermediate; Newcomer & Hammill, 1997)	Primary version assesses phonology, semantics, and syntax; Intermediate version assesses semantics and syntax
Receptive auditory/verbal skills	
Wepman Auditory Discrimination Test—Second Edition (Wepman & Reynolds, 1987)	Auditory attention, phonemic awareness, phonemic segmentation, phoneme position (primary/medial/recent)
Peabody Picture Vocabulary Test—Third Edition (PPVT-III; Dunn & Dunn, 1997)	Receptive vocabulary (visual scanning/impulse control); conormed with EVT (see below)
Token Test for Children (DiSimoni, 1978)	See NEPSY Comprehension of Instructions (Table 4.7)
Expressive auditory/verbal skills	
Controlled Oral Word Association Test (Spreen & Benton, 1977)	See NEPSY Verbal Fluency (Table 4.7)
Boston Naming Test (Goodglass & Kaplan, 1987)	Expressive vocabulary, free-recall retrieval from long-term memory versus cued-recall retrieval (semantic/phonemic)
Expressive Vocabulary Test (EVT; Williams, 1997)	Expressive vocabulary (picture naming); conormed with PPVT-III (see above)

sultation is often described as something a school psychologist will do before a standardized assessment, or instead of a standardized assessment. However, data collection is important in consultation too, and the fact that you are doing standardized assessments doesn't mean you can't do problem-solving consultation. All we are suggesting is that these two functions of school psychologists can be combined to make both stronger. You can bring assessment data into the consultation data-gathering phase when this is appropriate, linking interventions to the child's strengths and needs. And instead of being the mysterious "WISC jockey" who borrows a child for a couple of hours and then produces a useless report, you can ensure that the assessment you do is linked to the teacher's concerns and the child's performance in the classroom. The CHT emphasis on *ecological validity* and *treatment validity* is what sets our model apart from other test interpretation models. Most referrals for consultation concern academic problems, and most of those academic problems are reading difficulties (Bramlett, Murphy, Johnson, Wallingsford, & Hall, 2002). Although general consultation on reading instruction may be helpful, combining this knowledge with information about the multiple determinants of the child's problem can have important effects on the intervention you and the teacher choose, and on the success the child experiences as a result of your efforts.

Consultation is intended to be collaboration between equals, but the fact that the consultant is there to help the consultee solve a problem has the potential to make the power relationship unequal. Consultants tend to make requests at a high rate, and consultees are generally likely to respond by agreeing with these requests (Erchul & Chewning, 1990). It seems that many consultees agree with consultants during meetings, but don't really feel ownership of the interventions developed during consultation, because many of these interventions are not fully implemented (Wickstrom, Jones, LaFleur, & Witt, 1998). We believe that the power issues within the consultative relationship must be acknowledged and dealt with directly. Both school psychologists and teachers feel that expertise and informational power are essential in making changes with teachers (Erchul, Raven, & Whichard, 2001). You are using your expertise and knowledge to help solve a problem, influence a teacher to make changes, and support and develop the teacher's skills (Erchul & Martens, 2002). You can be directive and informative, such as telling a teacher about intervention research, without being coercive (Gutkin, 1999).

Consultation begins with the premise that the consultant works with the consultee (usually the classroom teacher) to solve a client's (the teacher's student's) problem. Although the two professionals are presumed to be equals, working together to help the child, it is also assumed that both professionals have specific expertise to bring to bear on the problem. In our view, your knowledge of neuropsychological and cognitive functions, neuropsychological assessment, the academic and behavioral intervention literature, and intervention-monitoring methodology should be the core of expertise that you as the consultant bring to the relationship. The teacher's knowledge of the student's classroom performance, awareness of effective and ineffective teaching techniques for this child, and professional expertise as a teacher form the core of his or her expertise as the consultee. Fully acknowledging the expertise of the consultee is one part of building rapport, but this knowledge is also necessary if an appropriate problem solution is to be found. An intervention plan that takes into account what resources are available and what interventions the teacher is already trying in the natural environment should have greater applicability and effectiveness (Riley-Tillman & Chafouleas, 2002). The following problem-solving consultation model is a summary of models presented by Erchul and Martens (2002) and Kratochwill, Elliott, and Callan-Stoiber (2002), combined with our CHT model.

Stages of Problem-Solving Consultation

Problem Identification

During the initial interview, the consultant (you) and the consultee identify a target behavior for intervention. The behavior must be defined in an observable, measurable way. In addition, information is needed about how often and when the behavior occurs, and a data collection method should be devised. Baseline data should begin to be collected. Problem identification in CHT is somewhat more complex than in other problem-solving models, as it includes data collected from prereferral interventions, permanent products, observations, interview, and preliminary assessment results that you need to check out with the teacher to ensure that your findings have ecological validity. This stage covers the initial theory and hypothesis steps in the CHT model (refer back to Figure 4.1).

Problem Analysis

During the second interview, a more in-depth study of the target behavior is made, including a functional assessment. An excellent resource for conducting a functional assessment is a handbook written by O'Neill and colleagues (1997) that includes reproducible forms. This assessment should include a review of the baseline data that have already been collected, and an interview with the teacher to identify possible causes, establish events, and determine consequences of the behavior. Most functional assessments focus on obvious causes for the behavior, such as seeking attention or escaping from a task. The CHT process will provide information about the student's cognitive processing strengths and weaknesses to use in developing hypotheses, such as processing difficulties, memory problems, language deficits, or difficulty with unstructured situations. As part of the problem analysis, a review of interventions that have already been attempted and their effectiveness is also helpful. Although CHT includes functional analysis in this stage, it relies on much more information from numerous data sources. Hierarchical ordering of preferred target behaviors is undertaken at this stage, but the nature of CHT may require more than one intervention for a particular child (e.g., reading fluency intervention, speech–language therapy for expressive language, occupational therapy for graphomotor skills). This stage is covered in the initial data collection/analysis and data interpretation steps of CHT, which provide a more detailed theory as to why the child is having difficulty.

Plan Development/Implementation

After the problem analysis, the *theory* is used by the consultant and the consultee to develop an intervention plan together (i.e., an effective intervention hypothesis). This plan takes into account not only the student's characteristics and behavior, but also the classroom ecology and the teacher's style and preferences. Working together, they brainstorm all possible interventions, then choose the intervention that is likely to be effective and can be plausibly implemented. Goals will be set, participants will be determined, and data collection will be initiated and continued during implementation of the intervention.

Plan Evaluation/Recycling

After an agreed-upon period of time, the consultant and consultee meet to review the collected data and evaluate the intervention (i.e., data collection/analysis and data interpretation). There are numerous methods for evaluating interventions via within-subject experimental designs, several of which we will review later in the chapter. If the intervention is successful, either the intervention is extended, or it is discontinued if the target has been reached. If minor revisions appear necessary, the consultee makes them at this time, and they decide on an additional meeting to evaluate the revised intervention. If different or more intensive interventions appear necessary (i.e., a new theory or hypothesis), a new intervention can be attempted, or additional special education support services may be needed. This process is also important as the instructional supports begin to be removed and the child begins to function completely within his or her natural environment with natural consequences. The theory–hypothesis–data collection/analysis–data interpretation cycle continues until the problem appears to be under natural stimulus–consequence control. As you can see, the CHT model is not really about testing per se; it is about a way of practice that combines the best technologies of problem-solving consultation with comprehensive evaluations.

Practicing Behavioral Neuropsychology

Since we are suggesting that you combine neuropsychological assessment with behavioral methods, In-Depth 4.1 and Table 4.11 review the basics of behavioral interventions for those readers

IN-DEPTH 4.1. Review of Behavioral Psychology Principles

RESPONDENT CONDITIONING TECHNIQUES

Respondent conditioning is a method of eliciting behavior by manipulating a stimulus. An example of a conditioned stimulus is the teacher's turning on and off the light to cue a child's transition behavior. Behavioral examples might include anxiety about tests or speaking in class, or fear when the teacher raises his or her voice. Common interventions, including relaxation training and systematic desensitization, may be used to treat anxiety responses in students. However, more broadly conceived, variations in stimuli can lead to different behaviors (e.g., varying spacing or size of letters during reading, using simultaneous visual and auditory teacher instructions, using an adapted pencil for sensory problems for writing, tapping on a desk to cue on-task behavior, etc.). Modeling and discriminative stimuli designed to elicit operant behaviors, though not considered respondant techniques, can both be related to stimulus–response psychology.

OPERANT CONDITIONING TECHNIQUES

Operant conditioning is a method of affecting behavior by manipulating the consequences of that behavior. Behaviors that are followed by reinforcing consequences (either presentation of something positive or removal of something negative) will tend to recur. Behaviors that are followed by punishing consequences (either presentation of something negative or removal of something positive) will be less likely to recur, as indicated in Table 4.11. One of the best uses of operant technology is the "Premack principle," in which a less reinforcing behavior is reinforced by a more reinforcing one (e.g., providing computer time after a certain level of reading accuracy is obtained). Positive reinforcement can include natural consequences (these are preferable) or secondary ones (e.g., tokens, points). A good use of negative reinforcement is reducing the workload if a child demonstrates mastery on an assignment.

People are often confused about the difference between *positive reinforcement* (presenting something positive) and *negative reinforcement* (removing something negative). Why do children have tantrums? Not only because they are positively reinforced for having tantrums, but their parents are negatively reinforced as well—they get peace and quiet by giving in to the children. Most interventions in school should use *positive reinforcers*, and these can even be used to teach children *not* to do something, so (we hope) you don't have to use punishment. You identify an alternative behavior, preferably one that is incompatible with the negative behavior, and reinforce that behavior (i.e., differential reinforcement of other/alternative/incompatible behavior). For example, Taniqua is always running in the halls. Instead of punishing her for running, reinforce her for walking. In some cases, a child may not be able to do the target behavior. In these situations, reinforcing successive approximations of target behaviors, or "shaping," is what we have to do with academic and behavioral deficits.

Is there a place for punishment in the schools? If a child is always being punished at school, it becomes aversive, something to avoid; it may even eventually lead him or her to drop out. A particular teacher who, or a subject that, is punishing may also be seen as aversive. There is another problem with punishment, though: The child isn't actually learning a replacement behavior. We prefer to use school interventions to teach children how to do something, rather than just to suppress negative behavior. If you must use punishment, we recommend that you use negative punishment that involves taking away something positive (either *time out from reinforcement* or *response cost*) combined with differential reinforcement. For example, if Kyle is aggressive on the playground, you can use negative punishment by having him sit on the sidelines and miss 5 minutes of recess, but you must also use positive reinforcement when you see Kyle playing nicely.

As you will recall from training, the schedules of reinforcement influence how a skill will be learned and maintained. Continuous reinforcement is good for skill acquisition, but this acquired skill will also be extinguished quickly, so intermittent reinforcement on a variable-ratio or interval scale is more appropriate. Think about slot machines; infrequent payoffs can maintain betting behavior for a long time! The same thing can happen in a classroom. If a teacher slips and accidentally reinforces an unwanted behavior, that behavior will be maintained longer.

TABLE 4.11. Reinforcement and Punishment

	Provide	Remove
Positive consequence	Positive reinforcement	Negative punishment (response cost)
Negative consequence	Positive punishment	Negative reinforcement

Note. Shaded boxes *increase* the preceding behavior; unshaded boxes *decrease* the behavior.

who may not recall the details. As part of the problem-solving model, you need to recognize that antecedent and consequent actions affect the child's learning and behavior, and that cognitive processes interact with these determinants. Having this understanding allows you to use what cognitive psychologists have called *stimulus–organism–response* (S-O-R) psychology, in which stimulus and response are still important, but the organismic variables (i.e., child neuropsychological processes) help you determine what the best intervention is and how to carry it out. The behavior technologies become especially useful in designing the intervention, determining intervention efficacy, and managing contingencies.

Developing and Evaluating Interventions

After cycling through the first four steps of CHT, and refining a theory as to what will help the child, you and the consultee need to use behavioral strategies combined with specific instructional methods to help the child learn—through either remediation, accommodations, or both. In Chapters 5–7, we offer a number of interventions for academic skills problems. Some problems transcend academic domain boundaries, and the comorbidity among academic learning disorders is quite high. To help you understand the relationship between neuropsychological functioning and academic domains, we have provided a worksheet in Appendix 4.5. This worksheet may be useful in your examination of the academic issues associated with a child's neuropsychological functioning. This ensures that when you identify the cognitive pattern of performance, you are relating it to the academic pattern of performance seen on testing and the classroom, which should help guide intervention planning and implementation. Taking what you know about the child's current level and pattern of performance, academic interventions, problem-solving consultation, and behavioral technologies, you can design, implement, and evaluate an intervention for him or her. In CHT, we recommend using single-subject (within-subject or single-case) research designs to evaluate the effectiveness of interventions. We believe that practitioners should collect child performance data on a regular basis to ensure that interventions are effective (Fuchs & Fuchs, 1986; Lindsley, 1991; Skinner, 1966; Ysseldyke, 2001). We recommend that similar models be used to evaluate any intervention, whether it is behavioral, academic, cognitive, or socio-emotional. In this section, we review the most useful designs for evaluating school-based interventions, illustrating each intervention model with hypothetical examples.

All of the research designs we discuss require two basic concepts. One is that you must have some way of *measuring the outcome* you want. Behaviorists generally call this "taking data," but you can think of it as "evaluating progress" or "checking up on the intervention." You can't simply say, "Yep, Jimmy's doing better"; you must have some way to *show* that the child is doing better. The outcome measure you choose depends on the target behavior and the goal of the intervention. You can use information that the teacher already collects (i.e., authentic data—homework completed, spelling test score, office referrals or detentions, absences, etc.). You can collect information as part of the intervention itself (e.g., math worksheets, curriculum-based measurement [CBM] probes of reading fluency, flashcards placed in correct and incorrect piles). You can also develop a data collection plan that interferes very little with the teacher's routine (e.g., child self-monitoring, using a wrist counter, completing end-of-the-period or end-of-the-day checklists). Finally, you can use systematic observation to observe the target behavior directly, using event, duration, latency, partial-interval, or whole-interval recording. With observational data collection, it is important to use a randomly selected peer at baseline to establish a discrepancy with the target child. Table 4.12 presents some suggestions for outcome measures that can be useful in the classroom.

The second basic concept is that you must have a *baseline* measurement, in addition to measuring the behavior during the intervention. Teachers are generally used to just measuring the outcome of teaching, such as giving a test at the end of a chapter. But to evaluate how effective an intervention is, you have to measure the child's performance at the start (without the interventions), and then keep measuring as you implement the intervention to see how the child's performance changes. Without having a baseline for comparisons, you won't know whether the child's improvement is really due to the intervention. In describing some of the intervention models below, we use the letter A to refer to the baseline condition. The other letters (i.e., B, C) represent whatever interventions you implement.

TABLE 4.12. Examples of Outcome Measures for School-Based Interventions

Outcome area	Possible measures
Several behaviors	Pre- and postratings on a brief behavior rating form. Daily report card with ratings for day. Systematic observation using event, duration, latency, partial-interval, or whole-interval recording.
Negative classroom behavior (e.g., calling out, getting out of seat, yelling, aggression)	Measurement of rate via tally marks, golf wrist counter, or pennies/ paper clips transferred from pockets. Student self-monitoring of behavior on sheet or card.
Serious negative behavior	Count of office referrals or detentions.
Positive classroom behavior (e.g., raising hand, giving correct answers)	Measurement of rate or student self-monitoring as above. Observational data as above.
Attention, on-task behavior	Periodic classroom observations. Child self-monitoring of skills.
Academic work completion	Worksheets or other permanent products. Measurement of accuracy, rate, or both.
Homework completion	Completed homework. Daily report card signed by parent and/or teacher.
Academic skills accuracy	Correct–incorrect flashcards kept in separate piles by student or peer. Worksheets graded in percentages correct and recorded in grade book.
Academic skills fluency (speed and accuracy)	CBM probes (Shinn, 1989).
Academic skills comprehension	Pre- and posttest with alternate forms.

ABAB/ABAC Designs

The ABAB design is used when you have picked one intervention and you want to see if it works better than the baseline condition (i.e., better than what the teacher would normally do). It is also sometimes called a "reversal design," because you do the intervention, then reverse to baseline for a short while, then do the intervention again. It's a good way to show that the intervention is really what's affecting the child's performance, but it doesn't work well for a situation where your intervention actually teaches the child something new. For example, if you teach a child to break a word into syllables to sound it out, you can't "unteach" that for the reversal phase. It also is not appropriate to do a reversal phase if the behavior you are trying to reduce is harmful to the child or others. For instance, if you are using time out to reduce hitting, it would be unethical to do a reversal phase. As a result, this design is best for situations where you want to change the *rate* at which a child does something that he or she already knows how to do. For an example of an ABAB design, please see Case Study 4.1 and Figure 4.2.

The ABAC design allows you to compare two different interventions to see whether they are different from the baseline, and to see which is better at changing the child's behavior. Similar to the ABAB design, you first collect baseline data, then implement the first intervention (B), then reverse to baseline, and finally implement the second intervention (C). For instance, after taking baseline data on multistep math addition item accuracy (A), you can determine whether a child is more accurate if he or she draws lines between columns (B), or follows a step-by-step algorithm

CASE STUDY 4.1. Jared's Impulsive Calling Out

An 8-year-old boy diagnosed with ADHD, Jared, was described by his teacher as extremely impulsive. The behavior that she identified as most problematic was Jared's calling out in class. Systematic observation data suggested that the teacher typically accepted Jared's answer when he called out, but then she often reminded him to raise his hand the next time. After discussing the baseline data with the teacher, we decided that she would use a wrist counter to count whenever Jared called out during whole-group instruction.

Figure 4.2 presents the results for the ABAB intervention designed to reduce his inappropriate call-out behaviors. During the first week, the teacher collected the baseline data. She counted Jared's call-outs without doing anything different about them, and this information was charted. The next week, the teacher continued to count Jared's call-outs, but she ignored him immediately after each call-out, practicing negative punishment. She only acknowledged Jared if he raised his hand first and did not call out, which was differential reinforcement. Notice that at first, Jared's call-outs increased. This is called an *extinction burst*—a very common finding when a previously rewarded activity is being ignored. After that, Jared's call-outs began to decline. The teacher then returned to baseline for a short time (accepting call-out answers and reminding him to raise his hand), and the call-outs became frequent again. After a few days of this, the intervention was reintroduced. As you look at Figure 4.2, you should notice a few things. Each phase is separated by lines and labeled, so the baseline and intervention phases are clear. Within the baseline phase, Jared was calling out very frequently; the average was about 20 times per day. During the first intervention phase, his call-outs increased at first and then began to decline. As soon as the reversal to baseline took place, they increased again to about 20 times per day. During the second (and final) intervention phase, call-outs declined to an average of only 8 times per day. You can clearly see that the intervention was what was affecting Jared's behavior (this is called *establishing functional control*), because every time the intervention was implemented, he changed his behavior.

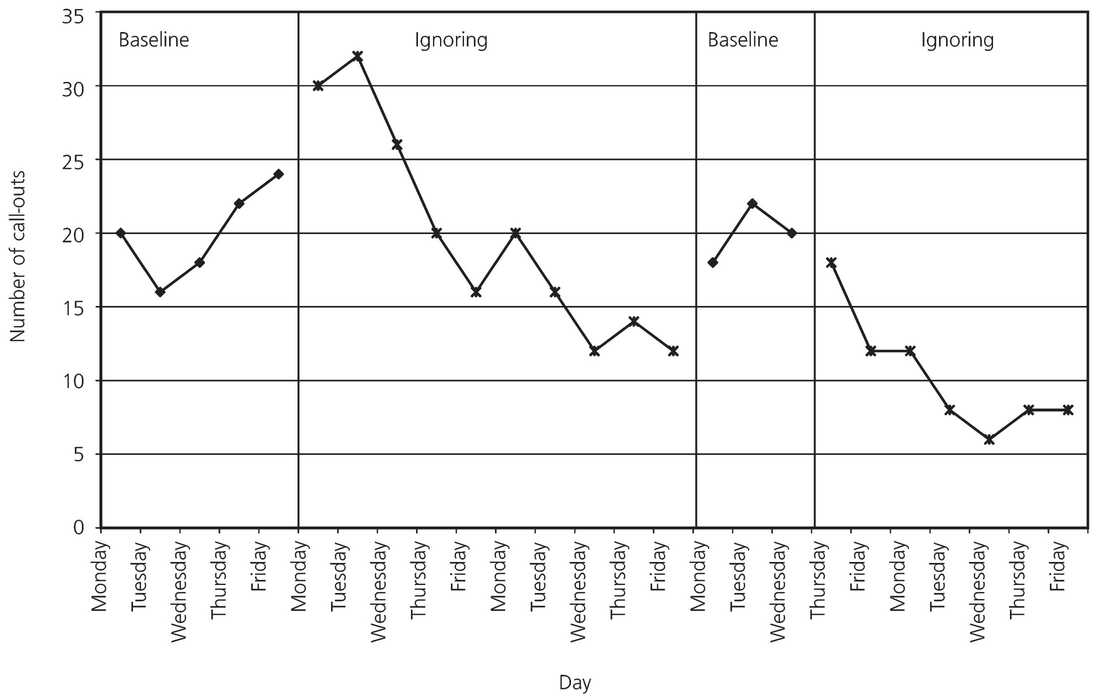

FIGURE 4.2. Jared's calling out.

sheet on how to complete the problems (C). Case Study 4.2 and Figure 4.3 provide an example of an ABAC design.

Multiple-Baseline Design

A multiple-baseline design is useful when you expect the child's learning to be cumulative, so you don't want to reverse success. This design can teach children to display target behaviors across settings, people, or behaviors. For instance, if staying on task is the target behavior, you first seek on-task behavior in one class, then another, and so forth. In this design, you collect baseline data in two or more subjects or at two or more times during the day. Then you start the intervention in one subject or at one time during the day, while continuing to take baseline data at the other time(s). Later, you introduce the intervention in the other subject or at the other time. If the child's performance changes in each setting only when the intervention is in place, you will know that the intervention is responsible for the change. An example of this design can be found in Case Study 4.3 and Figure 4.4.

Pre- and Posttest Design

A pre- and posttest design is useful when you can't collect data every day, but you want to measure the effectiveness of an intervention via direct observation, test, or rating scale. Although it is more difficult to establish functional control, it is an easier method of data collection and is more likely to be acceptable to teachers. For this design, it is important to choose a test (preferably one with alternate forms) or a rating scale that can be given repeatedly with minimal practice effects. The

CASE STUDY 4.2. Increasing Marcie's Reading Speed

Marcie was a 9-year-old girl who was pleasant, cooperative, and hard-working. However, she was a slow, choppy reader, and her teacher sought support in helping Marcie to read more fluently. Marcie was in a small reading group with three other children, and the teacher worked individually with Marcie for 15 minutes every day, but she was still struggling. The teacher now had an aide in class and wanted to know what the aide could do with Marcie. Based on the CHT evaluation information, I found that Marcie had good phonemic awareness skills, and her phonemic segmentation and blending were not problems, but her word finding and rapid naming skills were quite poor. I met with the teacher, and we thought of two possible interventions for Marcie: one where the aide would use flashcards to improve Marcie's speed at identifying words, and one where the aide would read orally with Marcie to increase the fluency of her reading. We decided that CBM of reading fluency, using daily 1-minute probes, would be a good outcome measure. As can be seen in Figure 4.3, her fluency was quite low at baseline (A). During the first intervention phase (B), the aide pronounced each word for Marcie; Marcie repeated it; Marcie and the aide then practiced with the flashcards for about 10 minutes; and they finished with another 1-minute CBM probe. After this intervention, the teacher returned Marcie to the baseline condition (A), but the aide continued to take CBM probes during this time. Finally, the second intervention phase was introduced (C). This intervention involved the aide's reading the passage to Marcie one time with expression and fluency, and then their reading it together in tandem for about 10 minutes. Again, the sessions ended with another 1-minute CBM probe. As you can see from looking at Marcie's chart, the flashcard drill improved her fluency over baseline, but the tandem reading was much more effective. This is not to say that tandem reading is a better intervention for all children; it just appeared to be better for Marcie.

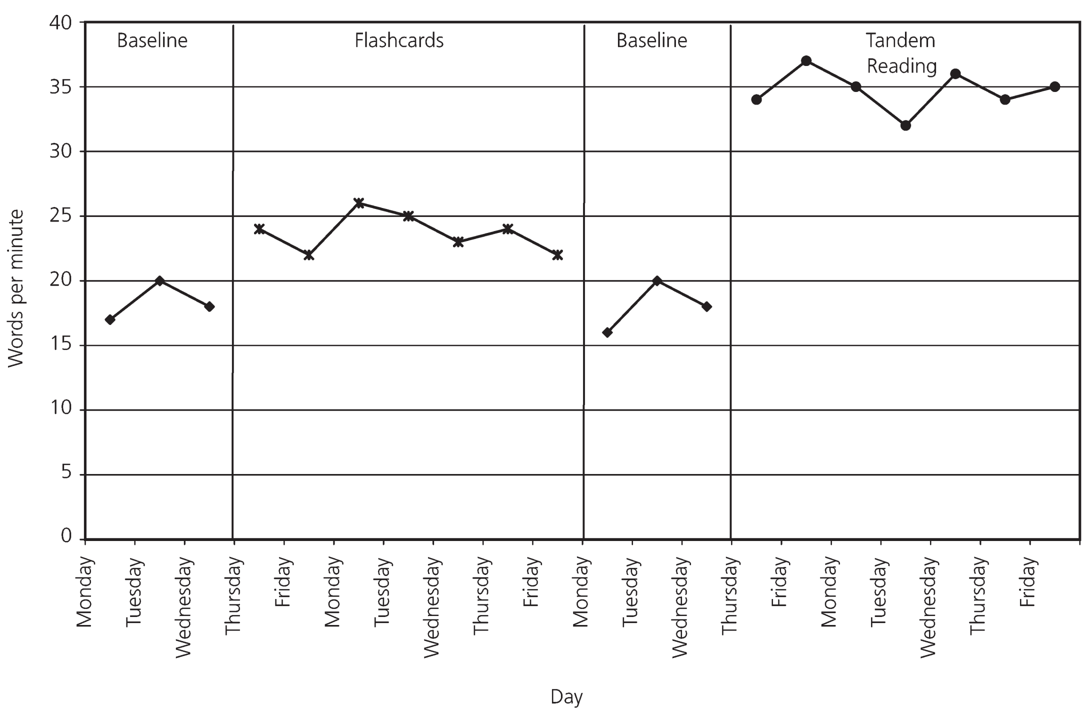

FIGURE 4.3. Marcie's reading fluency.

Case Study 4.3. Ellen's Accuracy Problem

Ellen was a 7-year-old girl who presented as a fast, careless worker. She reportedly completed her seatwork as fast as possible, without worrying about the accuracy of her responses. I (Fiorello) met with Ellen's teacher, and we decided to try to increase Ellen's accuracy by using rewards for correct responding. The teacher used Ellen's number correct on her seatwork papers to measure the outcome. She made sure that there were exactly 10 questions on each worksheet in math and spelling, and noted in her grade book the number correct for each day. For the first week, the teacher collected baseline data in both subjects for each day, and these data were charted on a multiple-baseline graph (see Figure 4.4). After collecting a week of baseline data, the teacher explained to Ellen that she could earn 1 point for each spelling word she copied correctly during seatwork, and the points could be traded for free time at the end of the morning classes. At the same time, Ellen's math work was kept in the baseline condition, with no rewards offered. As you can see from Ellen's chart, her spelling accuracy improved when rewards were added, but her math remained inaccurate. The next Monday, the teacher explained that the point system would apply to math as well, and as you can see from the figure, Ellen's accuracy in math improved thereafter.

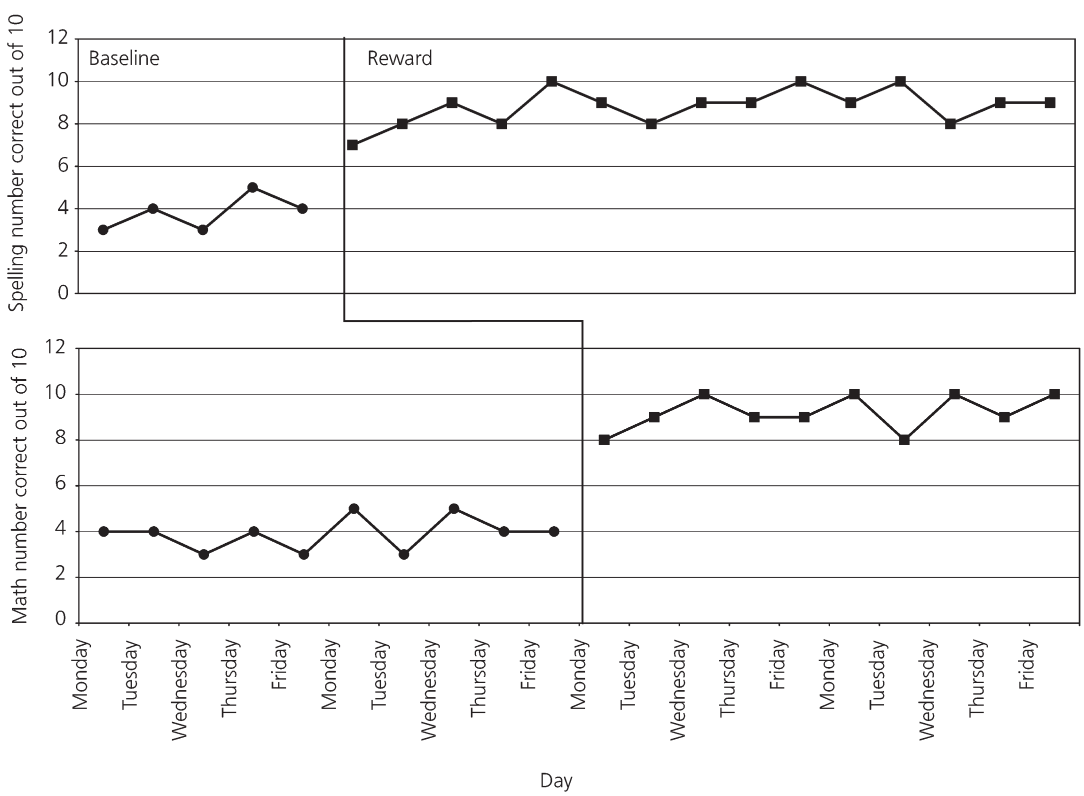

FIGURE 4.4. Ellen's accuracy.

pretest results become your baseline, and then you test again after implementation of the intervention to judge its effectiveness. Observations and brief rating scales can be used repeatedly if you choose to gather multiple data points during the intervention. Case Study 4.4 and Figure 4.5 provide an example of how to use a pre- and posttest design.

CBM Progress Monitoring

CBM is useful for evaluating the effectiveness of instructional interventions on reading, mathematics, and writing. A brief probe is completed for several days during baseline, and then repeated every 1–2 days following the intervention session. These data are plotted to gauge progress over time. An *aimline* shows the goal that has been set for the student. The beginning of the line is determined by the child's baseline performance or behavior; the end of the line is determined by where the child should be, compared to his or her peers, and how long it will take for the child to "catch up" once the intervention is in place. Unfortunately, there are no explicit guidelines for "how long it should take." For instance, if the child is 2 years behind, saying that he or she will make it up in a month is unrealistic. Conversely, it is inappropriate to give a child too long to catch up. After you establish an aimline, a *trendline* is drawn, which shows the rate of improvement in the skill. If the trendline is below the aimline for several days, the intervention should be adjusted or changed, or possibly you have set too high a goal for the child. Case Study 4.5 and Figure 4.6 highlight the use of CBM progress monitoring.

Multiple-Intervention Design

Before we leave our section on behavioral neuropsychology and problem-solving consultation, it is important to recognize that not all intervention designs discussed will fit nicely with the needs of a child, teacher, or parent. Certainly you want experimental control and good outcome data, but beyond that, you have to be sensitive to the needs of all parties, or the intervention effort will not be effective. Interventions that are easy are preferred, but they may not be effective. Others may be labor-intensive and have good experimental control, but because they are so cumbersome, treatment adherence or integrity is limited. This is where you, as the consultant, must work with the consultee to take into account the nature of the problem, the environmental determinants of the problem, and the resources available to affect behavior change. Case Study 4.6 and Figure 4.7 provide an example of alternative treatments for a child who does not respond easily to interventions.

CASE STUDY 4.4. Herman's Auditory Processing

Herman was a boy with a common problem: a history of frequent ear infections (otitis media) and poor auditory processing. He was having difficulty learning the letter sounds in his kindergarten class. His teacher referred him to the reading specialist, who arranged for Herman to complete a 6-week computer-based auditory processing and phonics program. Before Herman began the program, I (Fiorello) was called in to develop a method for monitoring the efficacy of the program. We agreed that I would administer the CTOPP and CBM of the alphabet sounds and would chart his scores, as depicted in Figure 4.5. After 6 weeks, I administered both tests again. Since the CTOPP has age-based SSs, you can see that Herman's auditory processing improved over the course of the program. In addition, charting his improvement in letter sound knowledge helped the teacher compare Herman to other children, to guide her expectations for his curricular progress.

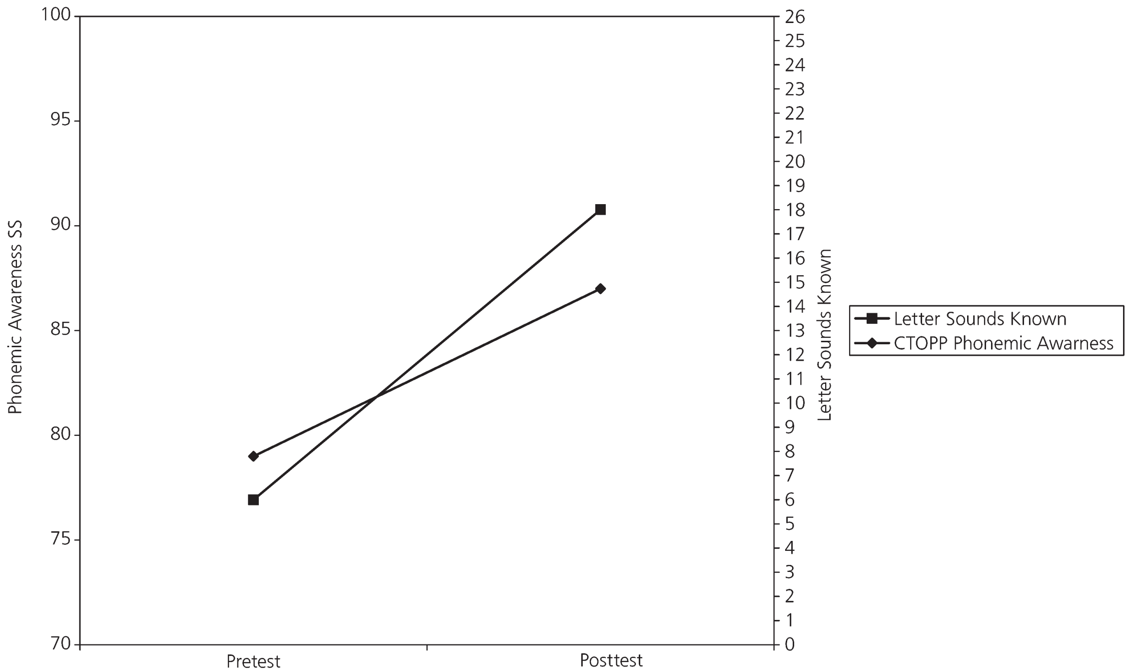

FIGURE 4.5. Herman's auditory processing and letter sound knowledge.

CASE STUDY 4.5. Beverly's Limited Expressive Language

When I (Fiorello) was called in to consult with Beverly's teacher, Beverly was having considerable difficulty with expressive language, primarily because she spoke very little during conversations with her teacher and peers. CHT results revealed difficulty with word retrieval, oral fluency, and expressive syntax. Data collection with an audiotape recorder began, and Beverly's oral fluency at baseline was found to be only 23 words per minute on average (see Figure 4.6). Her teacher set a goal of 45 words per minute, and we decided that a peer tutoring program would be implemented. The teacher picked a child who was not only friendly with Beverly, but also talkative, social, caring, and supportive. Each time the two children would get together, they would discuss a topic of interest. To facilitate this process, the teacher brainstormed possible topics with them before the intervention. As you can see, the peer tutoring improved Beverly's oral fluency at first, but on Days 10, 11, and 12, Beverly's fluency scores fell below the aimline. When three data points fall below the aimline, a decision point is reached. This means that it is time either to adjust or change the intervention, or to readjust the aimline. In Beverly's case, this ensured that goals would be set at a level where they could realistically be attained, while still ensuring that Beverly was making appropriate progress. It was decided that Beverly's goal might have been a little ambitious; however, she was making progress in the program and was developing a good relationship with the peer.

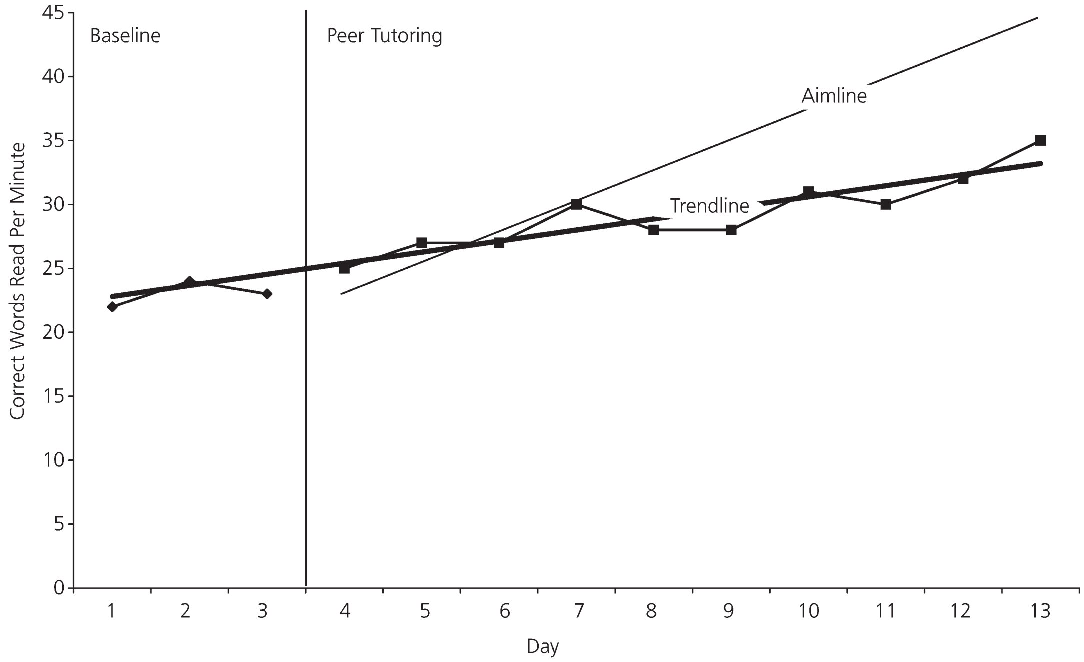

FIGURE 4.6. Beverly's CBM chart.

CASE STUDY 4.6. Coping with Gary's OCD

Gary was a student diagnosed with OCD. His classroom teacher's main concern was Gary's incessant questioning about assignments during seatwork. Gary typically asked for clarification of the directions, and the meaning of individual items. The teacher wanted to decrease Gary's questioning and increase his on-task behavior. She agreed to count Gary's questions with a wrist counter during the seatwork period in her class. As can be seen in Figure 4.7, Gary's baseline average was a little over 10 questions per period. We decided to try a number of interventions, starting with the easiest to implement and gradually adding more intrusive ones. This called for a variation on the ABAC design, where the interventions were cumulative (it might be called an A-B-BC-BCD design). First, the teacher developed a checklist for completing seatwork, and she taught Gary to use it to answer his own questions. She then laminated it and let him check off each item for himself. During this intervention, Gary's questions decreased slightly, to an average of about eight per period. The next intervention added was a set of five tokens that Gary had to use to ask questions. He would turn in one token every time he asked a question; any question after that would not be answered. Gary's questions decreased again, eventually settling at five per period. At this point, the teacher added one more intervention: She provided Gary a reward—a choice of activity during the last 5 minutes of class—if he had one token left at the end of the period. This lowered Gary's questions to four immediately. If the teacher had felt that even fewer questions would be allowed (based on what was normally acceptable in class, perhaps one or two), she could have gradually increased the number of tokens necessary for a reward.

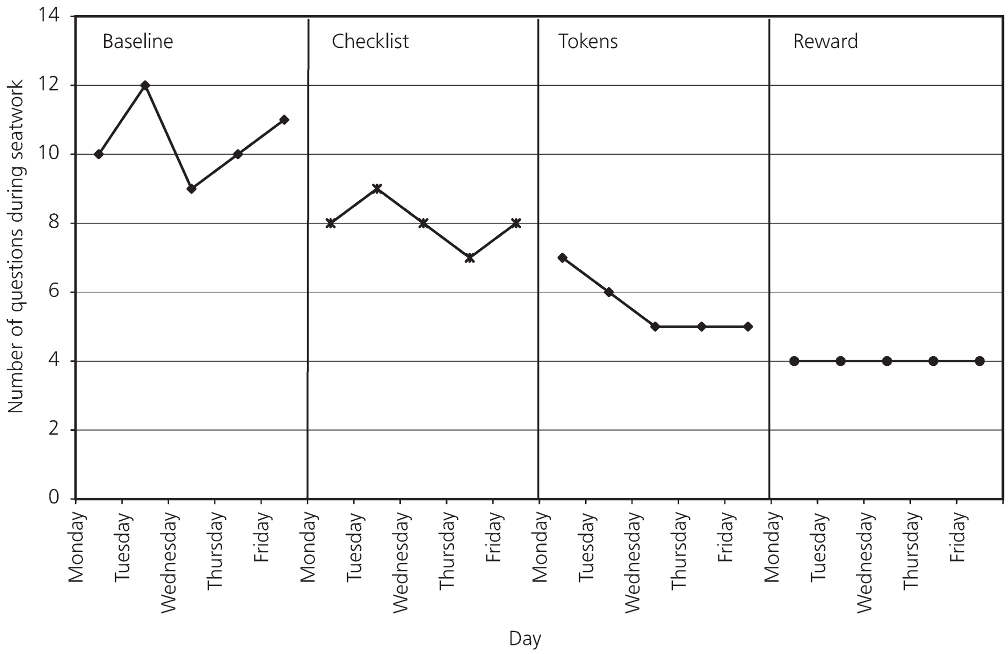

FIGURE 4.7. Gary's teacher questions.

LINKING ASSESSMENT TO INTERVENTION: A CASE STUDY

Considerations and Caveats

Now that we have given you a good understanding of assessment practices and measures, brain–behavior relationships, and consultation and intervention technologies, the next step is to bridge the gap between these apparently disparate areas of psychology. We provide you with one more case study, and detailed information in Chapters 5–8, in an attempt to make assessment information meaningful for individualized interventions for children with unique assets and deficits. As noted previously in this book, this is a tall order; it is a path that some have chosen, but few have found success in their quest. You may be disappointed to find that we don't offer you diagnostic–prescriptive advice in the following chapters. We feel that this is where the early researchers on aptitude–treatment interactions went astray: Not all children learn the same way, even if they show similar neuropsychological profiles, so we don't oversimplify things by saying, "If you have this disorder, then do this intervention."

To paraphrase an old adage, some interventions work for some children some of the time, but no interventions work for all children all of the time. You may feel confident that you have a good understanding of a child's neuropsychological strengths and weaknesses, but if you don't have ecological and treatment validity, then your results are of questionable value. Even if you have a good handle on the problem and the findings have ecological validity, the intervention you and the teacher choose may be ineffective. Don't dismiss the original findings; rather, try to understand why the intervention you thought would be effective was not, and try to modify it or try another intervention. This recycling of interventions is necessary, whether you use a CHT approach or a regular behavioral consultation method. We provide you with assessment and intervention information about various learning and behavior disorder subtypes, but it is up to you to use CHT with the technologies presented in this chapter to individualize interventions for the children you serve.

Cognitive Hypothesis Testing for Scott's Motor Problem

Case Study 4.7 and Figure 4.8 present the completed CHT worksheet (see Appendix 4.3) for Scott, a student referred for "motor problems" in the classroom. We have purposely picked Scott's case because it highlights the use of CHT without the use of "neuropsychological" tests. We do this so that you can become familiar with the CHT procedure while using tests you already know. This also demonstrates that CHT and neuropsychological analysis of the data can occur with typical cognitive/intellectual measures. In Chapters 5–8, we will provide you with several reading, mathematics, written language, and emotional/behavior disorder case study examples that use CHT and the neuropsychological tests described earlier in the chapter.

As you can see from Scott's case, the original "theory" about motor problems was not quite right, as the deficit appeared to be related to visual–spatial dorsal stream functions, or poor perceptual feedback to the motor system. The process would have continued with this case had all results come back negative. For instance, we may have wanted to check out left parietal somatosensory functions, but Scott didn't show differences in writing pressure. He could have also had difficulty with integration of information across the midline or bimanual functions, suggesting problems with the corpus callosum. We could have done additional neuropsychological tests to look at these, but found enough testing and ecological validity evidence to support our hypothesis.

Although Case Study 4.7 and Figure 4.9 suggest that Scott's intervention was effective, it should be noted that Scott was receiving occupational therapy during this time, so the positive results could have been related to this intervention. Obviously, as time went on, both interventions may have had a positive and complementary effect. This is not a good empirical practice per se, as we don't want two interventions going on at the same time. However, our experience suggests that the experimental rigor required of articles published in, say, the *Journal of Applied Behavior Analysis* may not always be feasible in the field. The bottom line is that we need to help children, and if they get better and we have data that show it, we are better off as a result. Now that we have the methods to link assessment to intervention, the remainder of this book will focus on the neuropsychological aspects of specific academic and behavior problems experienced by the children we serve.

CASE STUDY 4.7. CHT for Scott's Motor Problem

Scott, aged 9-9, had attention, social, and handwriting problems. The teacher referred him for "fine motor problems," because his work was always messy, and there were many erase marks and smudges on the work he turned in. His poor alignment of columns resulted in many math calculation errors on multistep problems. After prereferral strategies were unsuccessful at improving the quality of this work, he was referred for a comprehensive CHT evaluation. As can be seen in Figure 4.8, the initial assessment with the WISC-IV suggested strengths in auditory working memory, and three possible weaknesses: spatial visualization, visual–motor coordination, and/or visual memory. Having developed a theory as to what was difficult for Scott, I (Fiorello) needed to test my hypotheses one by one to see which ones were correct.

To examine these possible problems, I wanted to use untimed visual processing tasks that did not require motor output. I picked the WJ-III Spatial Relations and Picture Recognition subtests to look at spatial visualization and visual memory. Then I decided to choose a task measuring motor coordination and speed without significant visual processing to look at motor functioning. For this, I picked the motor portion of the Beery Developmental Test of Visual–Motor Integration (VMI). Based on the overall profile and results of these hypothesis testing subtests, only the Spatial Relations subtest was impaired; this suggested that Scott's difficulty was more of a dorsal stream problem than a ventral stream or frontal motor problem.

However, these findings would be considered tentative until I checked to make sure that the results had ecological validity. The information from the teacher interview and ratings, classroom behavior observations, and work samples provided the necessary confirmation that Scott had difficulty with spatial processing and perceptual feedback to the motor system. At this stage, it is important to remember to check for possible alternative explanations to the hypothesis, in order to avoid confirmation bias. For Scott, you will notice that work samples showed problems with spatial organization on the page and poor column alignment in math. In addition, the teacher interview indicated that Scott had problems during recess and gym with respecting peers' personal space. As a result, these apparently disparate findings were entered in the ecological validity section.

At this point, I felt I had a fairly clear understanding of Scott's strengths and weaknesses. My understanding of neuropsychology helped to clarify why Scott was having attention and social problems as well, since right parietal lobe dysfunction can lead to neglect of self and environment. I now had a "theory" as to why Scott was having problems with learning and social functioning, and I could now meet with the teacher to discuss interventions, developing hypotheses about what interventions might work, implementing the most probable one, and determining whether it was successful.

To begin this process, I completed the assessment of academic skill problems and cognitive weaknesses. Next, I examined resources available and cognitive strengths for possible use in the intervention. For Scott, the team referred him for occupational therapy, and I made classroom recommendations to improve his current academic functioning. I met with the teacher, and we decided to focus on his messy work/handwriting problem. The teacher liked the idea of using graph paper, and we decided that Scott would be rewarded for staying within the lines on his writing assignments first, and on his math assignments second. After completing his assignments, Scott completed a checklist that indicated how many times his writing went outside the prescribed lines. For each word or problem Scott stayed within the lines on, he received a token reinforcer that could be traded in at the end of the day for a computer time reward. This setup called for a multiple-baseline design as described earlier. In Figure 4.9, notice how Scott showed some improvement in writing, but math difficulties were still prominent. After the intervention was implemented during math class, Scott began to improve in both areas.

Student's name: Scott Age: 9-9 Grade: 4

Reason for referral: Messy written work, poor handwriting

Preliminary hypotheses—Based on presenting problem and initial assessment, the following cognitive strengths and weaknesses are hypothesized:

Strengths:

Auditory working memory

Possible weaknesses:

Spatial visualization
Motor coordination
Visual memory

Hypothesis testing—Follow up with related construct tests:

Areas of suspected weakness:

Spatial visualization
Motor coordination
Visual memory

Follow-up tests:

WJ-III Spatial Relations
Beery VMI inc. motor section
WJ-III Picture Recognition

Strengths/weaknesses:

Spatial relations on WJ-III well below average—Weak spatial visualization
Motor coordination on VMI average—No motor weakness
Picture recognition on WJ-III average—No visual memory weakness

Associated with academic and/or behavior problems?:

Yes—Spatial visualization weakness can lead to poor handwriting (spacing and letter formation) and messy work layout on page.

(continued)

FIGURE 4.8. Completed Cognitive Hypothesis-Testing Worksheet (see Appendix 4.3) for Scott.

Ecological validity—Information from observations and teacher ratings:

Strengths:

Participating in class discussion

Possible weaknesses:

Spatial organization—layout on page, trouble aligning columns in math, difficulty with peers in recess and gym re: "space"

Evaluation summary—Based on analysis of all evaluation information, the following cognitive strengths and weaknesses are identified, and concordance or discordance is calculated if necessary:

Cognitive strengths:

Oral language
Auditory memory

Concordant with academic and/or behavioral strengths?:

Yes—class discussion relies on oral language and auditory skills.

Weaknesses:

Spatial visualization and organization in space

Concordant with academic and/or behavioral weaknesses?:

Yes—spatial visualization is related to work layout, handwriting, and interpersonal space issues.

Discordant with cognitive strengths?:

Yes—spatial visualization is mediated by right occipital lobe, while oral language and auditory memory is primarily mediated by left hemisphere.

(continued)

FIGURE 4.8. *(continued)*

Summary of evaluation information for intervention development	
Academic/behavioral presenting problems: Messy work Poor handwriting	**Cognitive weaknesses:** Spatial organization and processes
Resources for intervention in environment: Consultant available Special education and OT consult and materials	**Cognitive strengths:** Oral language Auditory memory

Potential interventions:

Use paper with raised lines and graph paper for written work.
Allow dictation for lengthy written assignments.
Teach keyboarding skills.
Work with psychologist on interpersonal space issues.

FIGURE 4.8. *(continued)*

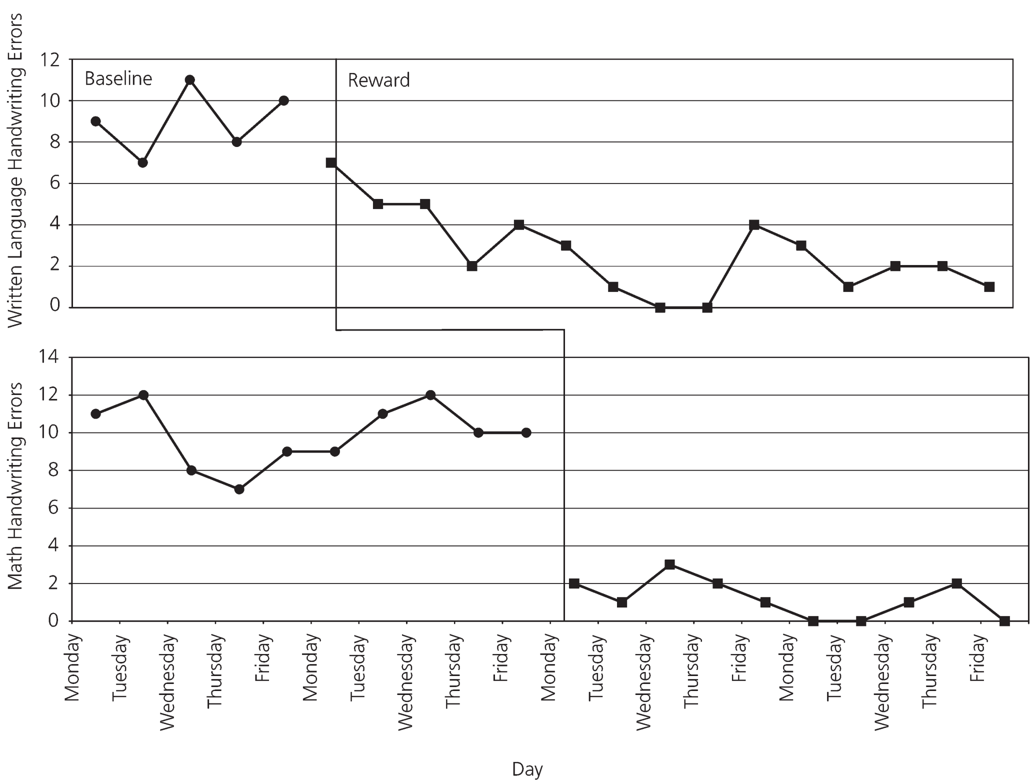

FIGURE 4.9. Scott's graph paper intervention.

APPENDIX 4.1. Demands Analysis

Student's name: ______________________ Age: ________ Grade: ______

Test/subtest ____

Input (check all that apply)	Processing (check all that apply)	Output (check all that apply)
Instructions	Left hemisphere	Oral
❑ Demonstration/modeling	❑ Concordant/convergent ("explicit")	❑ Brief oral
❑ Gesture/pantomime	Right hemisphere	❑ Lengthy oral
❑ Brief oral directions	❑ Discordant/divergent ("implicit")	❑ Report of strategy use
❑ Lengthy oral directions	Executive functions (frontal–subcortical circuits)	Motor
Timing	❑ Sustained attention/concentration	❑ Fine motor—point
❑ Overall time limit	❑ Inhibition/impulsivity	❑ Fine motor—graphomotor
❑ Speed bonus	❑ Working memory (specify ____________)	❑ Fine motor—manipulatives (e.g., blocks, pictures)
Teaching	❑ Flexibility/modify/shift set	
❑ Sample item	❑ Performance monitoring/benefit from feedback	❑ Visual–sensory–motor integration
❑ Teaching item(s)	❑ Planning/organization/strategy use	❑ Gross motor
❑ Dynamic assessment	❑ Memory encoding/retrieval	Written language
❑ Feedback when correct	❑ Novel problem solving/reasoning	❑ Brief written response
❑ Querying	❑ Temporal relationships/sequential processing	❑ Lengthy written response
Visual stimulus	❑ Expressive language (L R)	Response format
❑ Pictures/photos	Neuropsychological functional domains	❑ Open/free-response
❑ Abstract figures	❑ Sensory attention (T O P) (L R)	❑ Constrained/multiple choice
❑ Models	❑ Primary zones (T O P) (L R)	
❑ Symbols (letters, numbers)	❑ Secondary/tertiary zones (T O P) (L R)	

❑ Written language ❑ Large–small ❑ Color important Auditory stimulus ❑ Brief verbal ❑ Lengthy verbal ❑ Spoken ❑ Tape/CD (headphones used? Y N) ❑ Background noise Content L M H Cultural knowledge L M H English-language knowledge L M H Emotional content	❑ Prior learning/long-term memory ❑ Sensory–motor coordination ❑ Multimodal integration ❑ Dorsal stream (occipital–parietal) ❑ Ventral stream (occipital–temporal) ❑ Receptive language (L R) CHC abilities and narrow abilities Higher-level processing ❑ *Gf*—fluid reasoning ________ ❑ *Glr*—long-term storage and retrieval ________ ❑ *Gv*—visual processing ________ ❑ *Ga*—auditory processing ________ Lower-level processing ❑ *Gs*—processing speed ________ ❑ *Gsm*—short-term memory ________ Acquired knowledge and achievement ❑ *Gc*—crystallized intelligence ________ ❑ *Grw*—reading/writing ________ ❑ *Gq*—quantitative ability ________	**Other** Input: ________________ ________________ ________________ Processing: ________________ ________________ ________________ Output: ________________ ________________ ________________ Comments: ________________ ________________ ________________

In the "Input" column: Y N, yes or no; L M H, low, medium, or high. In the "Processing" column: L R, left or right; T O P, temporal, occipital, or parietal; CHC, Cattell–Horn–Carroll.

APPENDIX 4.2. Brief Demands Analysis

Student's name: ______________________________ Age: ______ Grade: ______

	Test/subtest	Input	Processing	Output
Strengths				
Weaknesses				

APPENDIX 4.3. Cognitive Hypothesis-Testing Worksheet

Student's name: ______________________________ Age: __________ Grade: ________

Reason for referral: ____

____

____

Preliminary hypotheses—Based on presenting problem and initial assessment, the following cognitive strengths and weaknesses are hypothesized:

Strengths:

Possible weaknesses:

Hypothesis testing—Follow up with related construct tests:

Areas of suspected weakness:

Follow-up tests:

Strengths/weaknesses:

Associated with academic and/or behavior problems?:

(continued)

Ecological validity—Information from observations and teacher ratings:

Strengths:

Possible weaknesses:

Evaluation summary—Based on analysis of all evaluation information, the following cognitive strengths and weaknesses are identified, and concordance or discordance is calculated if necessary:

Cognitive strengths:

Concordant with academic and/or behavioral strengths?:

Weaknesses:

Concordant with academic and/or behavioral weaknesses?:

Discordant with cognitive strengths?:

(continued)

Summary of evaluation information for intervention development	
Academic/behavioral presenting problems:	**Cognitive weaknesses:**
Resources for intervention in environment:	**Cognitive strengths:**
Potential interventions:	

APPENDIX 4.4. Neuropsychological Assessment Observations Checklist

Student's Name: ________________________________ Age: __________ Grade: ________

1. Pays close attention to task.	1 2 3 4 5	Has difficulty with selective or sustained attention.
2. Attention is consistent despite distraction.	1 2 3 4 5	Is easily distracted by external stimuli.
3. Shows good impulse control.	1 2 3 4 5	Is overly impulsive.
4. Shows appropriate activity level.	1 2 3 4 5	Has inappropriate activity level (specify: low or high).
5. Affect/mood is appropriate.	1 2 3 4 5	Affect is not appropriate (specify:).
6. Works quickly when appropriate.	1 2 3 4 5	Pace is too slow.
7. Can hold information in working memory to respond to questions.	1 2 3 4 5	Has difficulty retaining information in working memory to answer questions.
8. Can switch easily from one task to another.	1 2 3 4 5	Has difficulty switching tasks.
9. Plans/organizes before responding.	1 2 3 4 5	Responds without planning or organization.
10. Evaluates performance/modifies behavior.	1 2 3 4 5	Does not evaluate performance or modify behavior.
11. Comprehends orally presented information.	1 2 3 4 5	Does not comprehend orally presented information.
12. Follows directions or answers questions without repetition.	1 2 3 4 5	Requires frequent repetition of directions and questions.
13. Has adequate syntax and grammar.	1 2 3 4 5	Has difficulty with syntax and grammar.
14. Completes directions with one or more steps.	1 2 3 4 5	Has difficulty with sequential processing of directions.
15. Expresses self fluently.	1 2 3 4 5	Has difficulty expressing self fluently.
16. Does not exhibit word-finding difficulty.	1 2 3 4 5	Has word-finding difficulty.
17. Verbalizations are logical and organized.	1 2 3 4 5	Verbalizations are rambling and tangential.
18. No difficulty with nonliteral, metaphoric, or figurative language.	1 2 3 4 5	Language is overly literal and concrete.
19. Articulation is clear.	**1 2 3 4 5**	**Has poor articulation or phonemic paraphasias.**
20. Can easily recall information from long-term memory.	1 2 3 4 5	Has difficulty recalling information from long-term memory.

(continued)

21. Learns new material without repetition.	1 2 3 4 5	Needs many repetitions to learn new material.
22. Can learn new associations with few errors.	1 2 3 4 5	Makes frequent errors when learning new associations.
23. Can perceive and differentiate colors.	1 2 3 4 5	Appears to be partially or completely color-blind.
24. Easily discriminates/perceives visual stimuli.	1 2 3 4 5	Has poor visual acuity or visual perception.
25. Perceives visual stimuli throughout visual fields.	1 2 3 4 5	Has visual neglect. (Side? __)
26. Easily understands body language.	1 2 3 4 5	Has difficulty understanding body language.
27. Perceives spatial/holistic/global relationships.	1 2 3 4 5	Does not readily identify spatial/holistic/global relationships.
28. Shows no spatial configuration breaks.	1 2 3 4 5	Shows configuration breaks.
29. Shows no directional confusion.	1 2 3 4 5	Has directional confusion/orientation problems/reversals.
30. Perceives objects and faces.	1 2 3 4 5	Has difficulty perceiving objects and faces.
31. Can easily perceive auditory stimuli.	**1 2 3 4 5**	**Has difficulty perceiving auditory stimuli in the R __ and/or L __ ear.**
32. Hears and uses prosody effectively.	1 2 3 4 5	Has difficulty with receptive or expressive prosody.
33. Perceives tactile stimuli well.	1 2 3 4 5	Has difficulty discriminating tactile stimuli.
34. Handles materials smoothly.	1 2 3 4 5	Is clumsy when handling materials.
35. Has good pencil control/graphomotor skills.	1 2 3 4 5	Has poor pencil control/graphomotor skills.
36. Has established handedness (side? __).	1 2 3 4 5	Has not established handedness.
37. Has good bimanual control.	1 2 3 4 5	Has difficulty with bimanual control or crossing the midline.
38. Has good gross motor skill.	1 2 3 4 5	Has poor gross motor skill (clumsy or awkward).
39. Has good balance.	1 2 3 4 5	Has poor balance.
40. Has good muscle tone.	1 2 3 4 5	Has tone problems (too floppy, too rigid).

APPENDIX 4.5. Psychological Processes Worksheet

Client's name: ______________________ Date of birth: __________

Clinician's name: ______________________ Date: __________

Identify the psychological processes associated with the student's identified learning deficits with a (–) sign, and the strengths with a (+) sign. Remember that more than one psychological process should be involved for identified deficits.

Attention and Executive Frontal Lobe Processes

	Basic reading	Reading comp.	Basic math	Math reasoning	Spelling	Written lang.	Oral exp.	Listening comp.
Sustained attention								
Selective attention								
Overall tone								
Planning								
Strategizing								
Sequencing								
Organization								
Monitoring								
Evaluation								
Inhibition								
Shifting/flexibility								
Maintenance								
Change								
Motor overactivity								
Motor underactivity								
Constructional apraxia								
Ideomotor apraxia								
Ideational apraxia								
Visual scanning								
Sensory–motor integration								
Expressive language								
Long-term memory retrieval								
Working memory								
Perseveration								
Grammar								
Syntax								
Math algorithm								
Problem solving								
Fluency/nonfluent aphasia								
Dysnomia								

(continued)

Attention and Executive Frontal Lobe Processes (continued)

	Basic reading	Reading comp.	Basic math	Math reasoning	Spelling	Written lang.	Oral exp.	Listening comp.
Paraphasia								
Circumlocution								
Confabulation								
Concept formation								

Comments: ______________________________

Concordant/Convergent Left-Hemisphere Processes

	Basic reading	Reading comp.	Basic math	Math reasoning	Spelling	Written lang.	Oral exp.	Listening comp.
Sensory memory								
Discrimination								
Perception (meaningful)								
Phonemic awareness								
Phonemic segmentation								
Phonemic blending								
Sound–symbol association								
Morpheme comprehension								
Lexicon/word comp.								
Sentence comprehension								
Literal/concrete/explicit comp.								
Math fact automaticity								
Long-term memory								
Declarative memory								
Automaticity								
Simple/rote sensory–motor integration								
Detail perception								
Sight word recognition								
Local/part/fine processing								
Dysphonetic								
Convergent thought								
Concordant thought								
Fluent aphasia								
Paraphasia								
Neologism								
Left–right confusion								

Comments: ______________________________

(continued)

Discordant/Divergent Right-Hemisphere Processes

	Basic reading	Reading comp.	Basic math	Math reasoning	Spelling	Written lang.	Oral exp.	Listening comp.
Sensory memory								
Discrimination								
Perception (abstract)								
Spatial processing								
Perceptual analysis								
Visualization								
Ambiguity								
Asomatognosia								
Prosopagnosia								
Agnosia								
Neglect								
Object visual perception								
Spatial visual perception								
Grapheme awareness								
Sensory integration								
Complex sensory–motor integration								
Constructional apraxia								
Prediction								
Inference								
Metaphor/idiom/humor								
Nonliteral/figurative/implicit comp.								
Social perception/judgment								
Prosody								
Word Choice								
Holistic/global/gestalt processing								
Whole/coarse processing								
Novelty/new learning/encoding								
Pragmatics								
Facial/body gestures								
Problem solving								
Dyseidetic								
Divergent thought								
Discordant thought								
Fluent aphasia								
Paraphasia								
Neologism								

Comments: ______________________________

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