One

FOUNDATIONS: MEMORY AND ITS MEASUREMENT

Generating meaning from these words is an impressive memory feat. You have to first remember procedural aspects like where to start on the page and to use your eyes and to scan left to right. You also need to remember what the various letter and word combinations represent phonetically and holistically. Then you need to remember what meaning to assign those many phonetic and visual combinations. You also need to remember the meaning at the beginning of a sentence until the end of the sentence, and the beginning of the paragraph until its end. Obviously, without memory, reading would be impossible. And actually, without memory, life as we know it would be impossible.

Memory is a central feature of human intelligence and is represented in nearly all day-to-day functions, be they intellectual, academic, social, vocational, or recreational. Memory makes us who we are and preserves our identity. Without the ability to recall our own personal history, we would be in a near state of confusion and constant dilemma. Indeed, the greatest tragedy of the dementias is that they eventually take from us who we are and what we know of ourselves. Memory allows us to acquire skills and knowledge, to perform our jobs, and to recognize and respond appropriately to our loved ones. Simply stated, memory is ubiquitous in daily life. *Memory,* as the term is used here, will reflect this commonsense understanding (i.e., the ability to recall an event, an object, or a behavior—to remember something).

While memory is a central cognitive process, it also is a very vulnerable brain function. Various trauma, minor or devastating, can affect the efficiency of the brain laying down new memories and/or retrieving those already stored. Generally speaking, if there is going to be some cognitive compromise resulting from a brain insult, it is most likely that memory will be among those processes negatively affected. Difficulties with memory and attention are the two most common complaints following even mild head trauma. Further, it seems that memory is susceptible to congenital vagaries as well. Therefore, memory, like intelligence, can be demonstrated to range widely across individuals, from very impaired to quite impressive, starting in early childhood. And like intelligence, there is developmental change associated with age. Therefore, it should not be surprising that psychologists, neuropsychologists, and neuroscientists have devoted and continue to devote much attention to memory and its measurement.

This book features the two major comprehensive memory batteries currently available for assessment of memory functions in children and adults—the *Wide Range Assessment of Memory and Learning–Second Edition* (WRAML2; Sheslow & Adams, 2003) and the *Test of Memory and Learning–Second Edition* (TOMAL-2; Reynolds & Voress, 2007). Each of these batteries is intended to sample reliably a variety of memory functions that are of clinical and theoretical interest for children, adolescents, and adults.

Memory can be broken down into a multitude of forms, or *types,* each of which has a seemingly endless number of variations of task, process, and stimuli. Depending upon one's theoretical orientation, distinctions among memory processes may carry such labels as abstract, meaningful, verbal, figural, spatial, associative, free recall, sequential, recognition, retrieval, procedural, episodic, working, and semantic, among others. There is no uniformly accepted terminology used to describe memory function. This diversity in memory terminology is rivaled only by the hundreds of terms designed to reflect specific aptitudes and personality characteristics.

A single task may carry multiple classifications legitimately because theories of memory and their terminology often overlap. Some have even considered this classic definition of learning as also defining memory (e.g., see Kolb & Whishaw, 2003). However, although the distinction may be to some degree artificial (anything recalled must have been *learned*), the WRAML2 and the TOMAL-2 distinguish memory and learning by providing subtests that assess both immediate memory as well as new learning over multiple trials, and subsequent recall of that newly acquired information. Although clinical utility was emphasized in the development of the WRAML2 and the TOMAL-2 as well as throughout this volume, researchers will also find the tests valuable in that their content provides reliable coverage of more, different memory functions for this age range than is available in any other co-normed, standardized format.

DON'T FORGET

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HISTORICAL FOUNDATIONS

Unlike some domains of psychological testing, memory assessment had a relatively strong empirical base upon which to build. That foundation has had many contributors. Hans Ebbinghaus is generally recognized as among the first to study memory. His now classic "forgetting curve" was published as part of numerous findings related to more than a decade of research on memory and forgetting (Ebbinghaus, 1885). Ebbinghaus operationalized what we now think of as *immediate memory* using a digit span task and nonsense syllables. He showed that the amount to be remembered affects performance and having a way to *chunk* information increased performance. The meaningfulness of the information to the learner was shown to affect retention too.

A contemporary of Ebbinghaus was Alfred Binet, famous for creating the first measures of intellectual ability. Less known is Binet's interest in many facets of memory. This focus is perhaps one reason that 20% of his first intelligence test (the 1905 Binet-Simon Scale) consisted of questions directly assessing immediate verbal and visual memory abilities.

While Sigmund Freud did not investigate memory per se, his revolutionary theory was heavily reliant on diverse memory mechanisms. Later, Karl Lashley (long-term memory) (1950), George Miller (and his "7 ± 2" rule) (1956), Alexander Luria (the case of S and his unlimited long-term memory) (2006), and many others contributed an enormous amount of research that help us better understand memory. A lengthier treatment of research "pioneers" who contributed both directly and indirectly to memory assessment can be found in comprehensive sources like Haberlandt (1999), Squire and Schacter (2002), and Kolb and Wishaw (2003). Memory research continues, embracing new technologies and focusing on such contemporary and applied topics as the impact of blast injuries on the memories of soldiers serving in Iraq using fMRI imaging techniques along with formal memory testing.

Yet, despite over a century of research on the topic of memory, the clinical assessment of normal and disordered memory has been fraught with problems (Fuster, 1995; Miller, Bigler, & Adams, 2003; Prigatano, 1978; Riccio & Reynolds, 1998), many of which stem from difficulties separating attention and memory as well as immediate memory from short-

DON'T FORGET

The two most common complaints of individuals following a closed head injury are difficulties with attention and memory.

term and longer-term memory (see especially Fuster, 1995; Miller et al., 2003; Riccio & Reynolds, 1998; and Riccio, Reynolds, & Lowe, 2001).

We have known for a long time that certain neurological disorders of adulthood that tend to occur in the elderly (but also may appear as early as 40 years of age—e.g., Alzheimer's Disease, Binswanger's Disease, Huntington's Chorea, Korsakoff's Syndrome, Pick's Disease) have a profound impact on memory, and the type of memory loss that a person displays may have diagnostic implications for that disorder. Numerous neurological disorders of children and adolescents (including epilepsy, head trauma, most of the more than 600 known degenerative neurological disorders, and neoplasms) also have implications for memory, but they have less predictable and more global or generalized effects on memory than with adults. Children diagnosed as learning disabled, whether one views this as a neuropsychological disorder or not, commonly show a variety of memory problems (Reynolds & Fletcher-Janzen, 1997; Riccio & Reynolds, 1998; Riccio & Wolfe, 2003). When these conditions are chronic, related memory problems persist into adulthood (e.g., Goldstein & Reynolds, 2005).

As part of the standard neurological exam dating back to the beginning of the last century, neurologists have always asked the patient questions concerning "today's date," current news items, and some recitation of letters, words, or sentences as a crude attempt to establish whether memory was "normal." Such a screening assumed that individuals free of neurological disease or disorder would have no difficulty recalling such simple items, in contrast to neurologically compromised individuals who would display some type of impairment. However, it became evident that neurological disorders impacted memory with such variability that more elaborate assessment methods were necessary. Neuropsychiatric and psychological problems (e.g., de-

DON'T FORGET

Children diagnosed as learning disabled commonly show a variety of memory problems.

pression) also are known to affect memory subsystems differentially across the age range; therefore psychiatrists, among others, also routinely include informal memory tasks within their *mental status exam* of children, adolescents, and adults. With children and adolescents, the variability of normal development further complicates this type of informal assessment practice, and often demands more sophisticated evaluation. Regardless of the age or presenting complaints, memory assessment is paradoxical in certain regards: Memory is both fragile and robust. While even slight, seemingly inconsequential blows to the head can cause substantial memory problems (Levin, Eisenberg, & Benton, 1989), some individuals with massive neoplasms or even hydrocephalic children with greatly reduced neural tissue will sometimes exhibit little memory compromise. Systematic evaluation of memory is required to understand learning and behavioral functions, and their normal range of variability seems to dictate standardized procedures such as those represented on the WRAML2 and the TOMAL-2.

Recognizing the need to go beyond the common neurological and psychiatric memory "exam," Luria (1966) devised a more thorough and insightful evaluation, but he continued in a clinical tradition that was difficult to subject to quantification. Similar to neurologists of his day, Luria would often employ impromptu methods to assess a particular patient suspected of impaired memory. Again, the diagnostic assumption was that the patient would either be "impaired" or "not impaired." Such a dichotomous and idiosyncratic approach in clinical practice, while sometimes creative, did not provide an approach that would lead to quantifiable procedures. While qualitative approaches provided a certain richness and flexibility diagnostically, they did not easily provide nuanced evaluation of milder deficit or identification of areas of memory strength. Further, qualitative approaches require many, many years of experience, supervision, and exposure to a wide range of pathology, not to mention the immense creativity and careful theoretical reflection required in the clinician. In contrast, Western psychology, with its legacy of quantification, strongly influenced neuropsychological and other forms of assessment to proceed in a more psychometrically exacting direction.

Much of the evolution in modern neuropsychology in the United States can be attributed to events associated with World War II. With dramatically improved emergency medicine in field hospitals, for the first time in the history of warfare many soldiers survived brain injury. Many of these victims had accompanying deficits in memory function. During this era the need for some type of standardization or *battery* of tests that could assess memory became obvious. Such a battery would depend on quantification so that useful information concerning the nature of the deficit could be reliably relayed from one health specialist to another. With the success of the *Wechsler-Bellevue Intelligence Test* in 1939, David Wechsler developed the *Wechsler Memory Scale* (WMS) as a "rapid, simple, and practical" measure of memory (Wechsler, 1945, p. 16). The *Wechsler Memory Scale* was rapidly incorporated into clinical practice and by the 1950s and 1960s was entrenched as the *only* measure of adult memory that could be compared with an intelligence quotient. The WMS and its revisions, WMS-R and WMS-III, however, are primarily adult measures, beginning at the upper ranges of adolescence. Memory problems in children and their impact on development, learning, and behavior simply were not emphasized or even recognized to the same extent that adult memory symptoms were.

During this same period of time (1940–1960), other tests of memory were being developed, most notably, *Rey-Osterrieth Complex Figure Design* (Rey, 1941), the *Rey Auditory Verbal Learning Test* (Rey, 1958), and the *Benton Visual Retention Test* (Benton, 1946). The *Rey Auditory Verbal Learning Test* was a list-learning task in which 15 words were presented to the patient over five trials. This would permit creation of a learning curve; and by using an interference procedure one could examine forgetting—a factor particularly important in certain neurological disorders (Lezak, 1983). Additionally, the words could be embedded in a paragraph so that recognition memory could be assessed. Although widely used as a clinical test, it was never fully standardized or normed. Additionally, the Rey auditory verbal learning approach did not permit a detailed evaluation of storage and retrieval of information. To examine these principles of memory more fully, and to apply them to a clinical procedure, Buschke and Fuld (1974) developed the *Selective Reminding Test.* With this procedure, the individual is told only the words that are "failed" on the previous trial, thereby allowing another method of studying long- and short-term retrieval from storage.

Visual memory has been typically assessed by the *Benton Visual Retention Test* (Benton, 1974) or the *Rey-Osterrieth Complex Figure Task* (Rey, 1941). Both have the confound of requiring the examinee to use graphomotor abilities; and if there is any disturbance in perceptual-motor functioning, this can affect performance on either one of these tasks adversely. The *Benton Visual Retention Test* has sound psychometric properties for older children and adolescents. Unfortunately, it has not been fully standardized in the lower age ranges. The Rey-Osterrieth figure is complicated and somewhat difficult to score, and this has presented obstacles in its use and clinical utility. Also, the delayed recall feature of the Rey-Osterrieth has never been fully standardized and normed, and numerous methods for assessing delayed recall have been suggested. Both of these measures have also been criticized because there is an element of verbal categorization that can be used so that the tasks may also tap verbal memory as well as the intended domain of visual memory.

As they developed over the years since the late 1930s, memory testing efforts continued to be focused primarily on adults. Nevertheless, some pediatric focus was evident. The various versions of the *Halstead* (and *Halstead-Reitan*) *Neuropsychological Test Batteries* (e.g., Reitan & Wolfson, 1985) routinely included several brief memory measures for children 6 to 14 years of age. However, psychologists engaged in the assessment of memory in children were often forced to use informal techniques (such as a *recall* segment following administration of Bender's 1938 *Bender-Gestalt Test*) as follow-up to any suspected memory problems arising from the few memory procedures included on formal intelligence batteries. Dorothea McCarthy (1972), a developmental psycholinguist, placed a Memory Index on the *McCarthy Scales of Children's Abilities,* but even this scale overlapped other scales and was spare in its coverage. It was not until the 1990s that the first comprehensive, pediatrically focused memory measures appeared—specifically the original versions of the WRAML (Sheslow & Adams, 1990) and TOMAL (Reynolds & Bigler, 1994b).

It is of interest to note that by the late 1980s, 80% of a sample of various testing experts noted memory as an important aspect of a cognitive assessment (Snyderman & Rothman, 1987). Yet, despite the recognized importance of memory assessment and the inclusion as brief recall tasks on most popular IQ tests since the early 1900s, widespread adoption of comprehensive memory batteries was not seen until the beginning of the 21st century.

Rapid Reference 1.1 lists the evolution of instruments used in clinical memory testing, and Rapid Reference 1.2 lists memory phenomena identified by various researchers over the last 130 years. Most terms in Rapid Reference 1.2 are recognized by psychologists, and many of these research *products* have been formative in defining the content of contemporary memory tests. Those memory phenomena found within the subtests of both the WRAML2 and TOMAL-2 are also noted in Rapid Reference 1.2. The meaning of the terms can be found in almost any introductory psychology or cognitive psychology text.

You will note that neither the WRAML2 nor the TOMAL-2 include long-term memory tasks.

DON'T FORGET

It was near the mid-20th century when the first comprehensive memory measures appeared, but widespread use of comprehensive memory batteries, like the WRAML2 and TOMAL-2, was not common until the beginning of the 21st century.

Rapid Reference 1.1

A Short Chronology of Memory Tests

1941. Rey-Osterrieth Complex Figure Task

1945. Wechsler Memory Scale (1987, Second Edition; 1997, Third Edition; 2009, Fourth Edition)

1946. Benton Visual Retention Test

1958. Rey Verbal Learning Task

1974. Selective Reminding Task

1987. California Verbal Learning Test

1990. Wide Range Assessment of Memory and Learning

1994. Test of Memory and Learning

1997. Children's Memory Scale

2003. Wide Range Assessment of Memory and Learning–Second Edition

2007. Test of Memory and Learning–Second Edition

In fact, there are no normed, psychometrically sound measures of long-term memory. This, obviously, is not because long-term memory is not an important aspect of our memory systems, but rather due to the difficulty of creating such a scale. In part, this is because everyone's background is different and so creating a scale not biased to one or more cultural backgrounds would be challenging. Further, item difficulties of a long-term memory scale likely would change frequently. Questions like, who is Catherine the Great? or what country has the largest Muslim population? can change in difficulty if a movie, video game, or breaking news story happens to highlight this information. A scale made up of such questions would have questionable validity. Therefore, because of a number of practical dilemmas, long-term memory,

Rapid Reference 1.2

Memory phenomena from past research found on the WRAML2 and TOMAL-2

Included in WRAML2?	Memory Phenomena	Included in TOMAL-2?
Yes	Anterograde amnesia	Yes
No	Retrograde amnesia	No
No	Episodic memory	No
Yes	Semantic memory	Yes
Yes	Explicit memory	Yes
Yes	Short-term (Immediate) memory	Yes
Yes	Longer-term (Delayed) memory	Yes
Yes	Recognition memory vs. retrieval	Yes
Yes	Meaningful vs. rote information	Yes
yes	Developmental changes with age	Yes
Yes	Working memory	Yes
Yes	Visual memory contrasted with verbal memory	Yes
Yes	New learning over trials, resulting in a learning curve	Yes
Yes	Eidetic memory	Yes
Yes	Meaningful vs. nonmeaningful memory comparisons	Yes

while important, is a domain of memory not measured in memory batteries. While there is evidence showing delayed memory, as assessed in the WRAML2 and TOMAL-2, is moderately to highly correlated with various types of longer term memory (Lezak et al., 2004), there are scant data showing this is true in clinical populations.

ANATOMY OF MEMORY

Another avenue of investigation that contributed significantly to our understanding of memory is neuroanatomical research. Although a comprehensive review of the neurobiology of memory is beyond the scope of this chapter, a brief discussion of the neural substrates of memory systems will provide an important backdrop to a discussion of memory assessment. For a more in-depth discussion, excellent reviews are provided by Squire and Schacter (2002), Kolb and Whishaw (2003), and Zillmer, Spiers, and Culbertson (2008). Knowledge of the neurological aspects of memory and its pathology are important in guiding understanding and interpretation of clinical observations and test findings.

For memories to be formed the individual must experience internal or environmental sensations; awareness is not necessary. While memories can be formed and retrieved within any of our sense modalities, within our culture, visual and auditory systems are central. Therefore, historically, assessment of memory focused on these two modalities, with a greater emphasis placed on verbal processing. The verbal versus visual memory distinction provides an important heuristic for the clinician in that the left hemisphere is more oriented toward processing language-based memory and the right toward visuospatial memory (Zillmer et al., 2008). It follows then, that bilateral damage often affects both verbal and visual memory.

Regardless of the sensory modality, several critical brain structures are involved in the development of memories, including the hippocampus, fornix, mamillary bodies, diverse thalamic nuclei, and distributed regions of the neocortex (see Figures 1.1, 1.2, and 1.3). Briefly, neural impulses travel from the sensory organs, primary cortex, and association neocortex to the medial temporal lobe regions including the hippocampal formation (Figure 1.1). The hippocampus and nearby structures (e.g., fornix, mamillary body, anterior thalamus) seem to be the

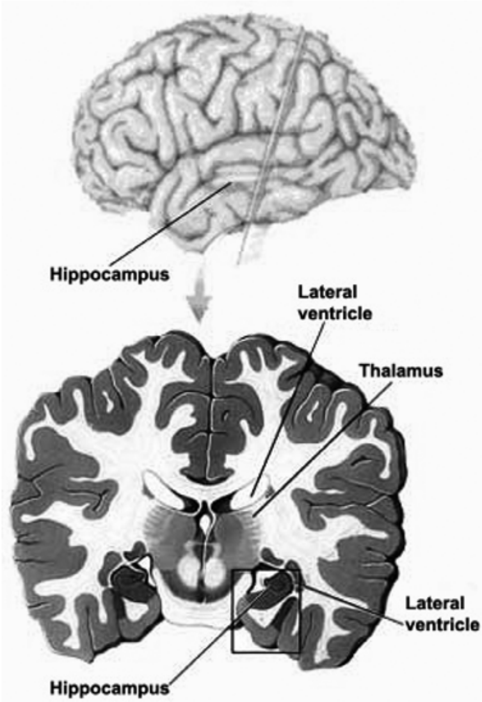

Figure 1.1. A coronal section of the brain showing the location of the hippocampus and related structures of both hemispheres.

(Used by permission, Bruno Dubuc, www.thebrain.mcgill.ca)

location where associations are formed between new incoming information and previously processed information. (Figures 1.2 and 1.3 show increasingly greater detail of this important area of the brain. Contemporary research of neuroscientists is examining functions of smaller and smaller areas within this region [e.g., the dendate gyrus, subiculum] and discovering yet greater complexity of memory storage and retrieval functions.) Damage to the hippocampal region can result in a person's being able to recall immediately a brief stimulus such as a picture or short sentence, but seconds later that information is no longer available to the person because the damaged region cannot help in storing new

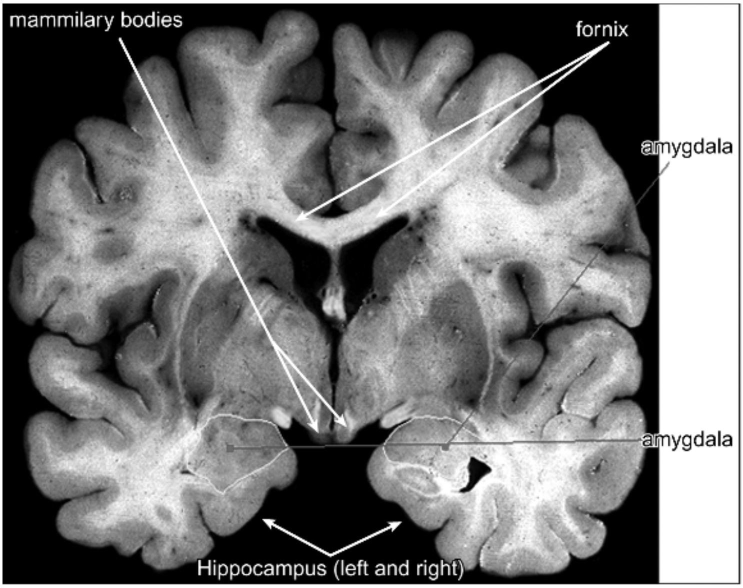

Figure 1.2 Hippocampus, fornix, and amygdala: bilateral, medial temporal lobe structures of the brain–coronal presentation.

(Used by permission, BrainInfo [2007], Neuroscience Division, National Primate Research Center, U. Washington, http://www.braininfo.org)

information. This was dramatically discovered from a client who in the mid-1950s underwent the surgical removal of much of the hippocampal structures in both hemispheres in order to remedy his intractable seizures (Corkin, 2002). While the surgery successfully eliminated most of the seizures, unfortunately it rendered the man, known as HM, mostly unable to lay down any new memories. HM's old memories remained available, but despite a normal IQ he was unable to function in contemporary society because his "conscious life" never progressed beyond the day of his surgery. Interestingly, *implicit* memory (memory not dependent on conscious learning) was much less impaired for HM. Subsequent research showed that unilateral lesions seldom produce severe global memory impairment. But dominant hemisphere (usually the left hemi-

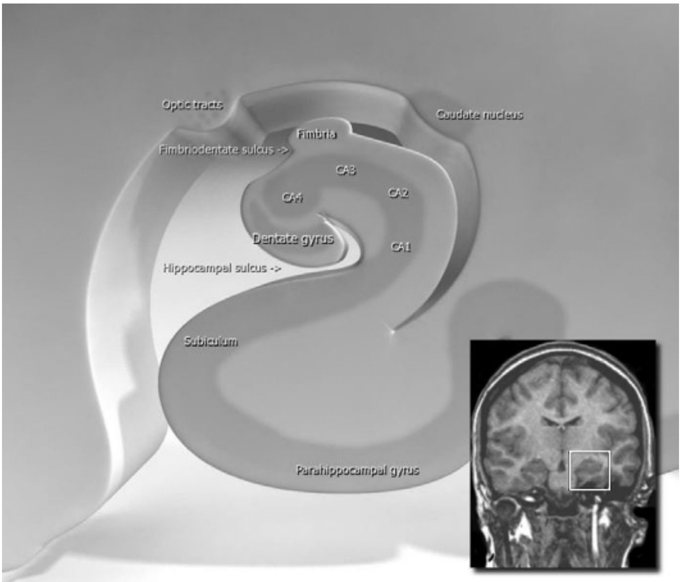

Figure 1.3 Some of the important hippocampal structures that are essential for laying down new memories.

(Image courtesy of Dr. Frank Gaillard, www.en.wikipedia.org/wiki/Image: Hipppocampus _(brain).jpg).

sphere) lesions in the hippocampal region can cause more noticeable deficits in laying down new verbal memories, whereas unilateral lesions of the nondominant (usually right) hemisphere tend to cause deficits in laying down new visual memories (Corkin, 2002). Further, Blumenfeld (2002) describes different cellular mechanisms (electrical and chemical) as well as anatomical structures that are also involved at different points within the time sequence associated with memory storage.

Examiners should have some basic knowledge of the neurobiology of memory because insult to various parts of the brain resulting from accident or disease or even genetic malfunctions may well disrupt memory function in a variety of ways and via more than one mechanism. In a discussion of the neurobiology of memory, two levels need to be considered: One is the cellular level; the other is the *system* level—that is, the synergistic interaction of nerve cells. At the cellular level, we know that a variety of changes may occur in an individual neuron, including alterations in its membrane and synaptic physiology. At the systems level, two critical regions mediate memory: the medial aspect of the temporal lobe (hippocampus and its connecting fibers, as with HM) and the midline structures of the diencephalon. Damage to either of these regions typically renders the individual impaired in establishing new memories (anterograde amnesia). An inability to recall past memories (retrograde amnesia) is commonly thought of as the definition of the term *amnesia,* and it can also be associated with hippocampal damage.

Research also demonstrates that the brain as a whole participates in memory functioning. Thus, patients with damage to the brain, regardless of its side or location, may be at risk for having diminished memory performance in a variety of domains. Accordingly, there seems to be a nonspecific lowering of memory performance associated with neurological dysfunction in general. It is not always clear whether this is attributable to pure memory systems or declines in attention and concentration, and assessing both is necessary. Attention is a precursor to memory (e.g., see Riccio et al., 2001). Damage to temporal and temporo-limbic structures will also disturb attention and concentration, as will frontal lobe damage—all of which may masquerade as memory deficiencies.

However, for intact brains, following new information entering the hippocampal circuit, long-term storage occurs as this structure seems to distribute the

DON'T FORGET

Anterograde amnesia refers to an inability or difficulty in establishing new memories.

DON'T FORGET

Retrograde amnesia refers to an inability or difficulty recalling previously learned information

information via various neural pathways to the cerebral cortex, where memories have received the most extensive processing and are the least vulnerable to injury. *Long-term memory,* the recall of well-established information or events, tends to be one of the most robust of neural functions, while sustained attention, concentration, and the formation of new memories tend to be the most fragile and subsequently the most sensitive to neural insult.

> **DON'T FORGET**
>
> Patients with damage to any region of the brain may be at risk for having diminished memory performance.

> **DON'T FORGET**
>
> Memory can be fragile or robust! Old established memories are the last to be disturbed in most forms of trauma and even in degenerative neurological diseases, but the ability to form and acquire new memories can be disrupted by even mild head injuries and such a disruption is often the first detected symptom of a degenerative central nervous system disease such as dementia of the Alzheimer's type.

Along with these information-laden *memory circuits,* a secondary emotional memory function is also stored with long-term memories. The amygdala and its surrounding structures are responsible for *coloring* informational memories with feeling. This emotional component has not been a focus of formal memory assessment, although it serves as an important cue when memories are retrieved. However, it is thought that the binding of emotion to informational aspects of memory is an ongoing part of memory that allows us to recognize whether positive, negative, or neutral affect is associated with a past occurrence and to act accordingly.

IN THE PAGES THAT FOLLOW

Using this impressive research legacy, a number of memory measures have been developed. This book is intended to introduce a variety of professionals to two widely used memory measurement batteries: the *Wide Range Assessment of Memory and Learning–Second Edition* (WRAML2) and the *Test of Memory and Learning–Second Edition* (TOMAL-2). The reader will be provided with a detailed presentation of the WRAML2 in the first half of the book, followed by a TOMAL-2 presentation in the latter half. Each test will be introduced with an overview of its format and test content. Then administration guidelines are discussed, including procedural suggestions and solutions for common problems examiners may encounter, most of which are beyond what will be found in each test's *Examiner's Manual.* Each test discussion concludes with extensive interpretive commentary based, in part, on recently completed research, as well as extensive clinical familiarity with the instrument. Each discussion of the instruments is written by a co-author of the instrument, and therefore, some bias undoubtedly slipped into the narrative. However, the authors tried to be objective and forthright in their treatment of the material, and it is hoped that the considerable familiarity each has with his instrument will provide a great amount of timely, authoritative, and useful information, and that will outweigh the potential of a less critical consideration. We hope you will find what follows of help clinically as you develop proficiency in the administration and interpretation of one or both instruments.

SOME CAUTIONS

Memory assessment is a particularly complex task requiring knowledge of lifespan developmental aspects, individual differences, psychometrics, individual assessment skills, and clinical acumen and experience not only with the tools of assessment. Evaluation of the pediatric and senior populations, as well as individuals with central nervous system trauma or disease, poses special challenges as well and requires far more than technical literacy with a test and its accurate administration. Memory is a complex phenomenon that, as we discussed earlier in this chapter, can be broken into numerous subcomponents, not all of which can be assessed with the WRAML2, TOMAL-2, or any one scale of memory. Further, and as mentioned earlier, many conditions other than memory deficits can mimic memory impairment. This is especially true for older clients whose medications may be taken improperly, younger adults who may be involved in recreational drug use, and in clients who are medically ill, such as those having hypothyroidism or undiagnosed renal problems. Even something as obvious as poor eyesight or hearing loss can be overlooked and misinterpreted as a memory deficit. A recently completed medical evaluation may be an important appointment for a *high risk* client prior to his/her assessment of memory functioning. Also, motivation can play a greater role in memory assessment, especially since tasks can seem less inherently interesting and feel more demanding of sustained effort. Therefore, significant fatigue or resentment from mandated testing can result in lower scores. In addition, one needs to be concerned about motivation to appear more impaired because of pending legal settlement.

Neither long-term memory nor incidental memory are assessed on the WRAML2 or TOMAL-2, although the delayed recall tasks of the two batteries are likely related to these components of memory. Distortions of initial perception and of retrieval processes are also relevant to understanding memory at all age levels, and the context of events and their recall may also strongly influence memory for day-to-day events. Complaints of everyday memory or learning problems re-

CAUTION

Some Memory Deficit Mimes

- Medical Illness (e.g., hypothyroidism)
- Hearing or Vision loss
- Fatigue
- Motivation
- Attention problems
- Emotional factors (e.g., depression)
- Medication mismanagement

DON'T FORGET

A thorough knowledge of client history and current physical status is crucial to memory test interpretation and the generation of useful recommendations.

quire additional information and investigation, particularly in the face of average or better WRAML2 or TOMAL-2 performance. Regardless, a careful and comprehensive history of the client is essential for targeting and understanding the nature of memory deficits and how they are impacting a given client's everyday functioning. A thorough knowledge of client history and current status is crucial to memory test interpretation and the generation of useful recommendations.

When viewed in the context of a thorough individual assessment, the WRAML2 and the TOMAL-2 should answer most questions regarding the nature and level of memory functions for a particular individual. However, these test results must be viewed in context. Anxiety and other psychiatric symptoms may interfere with memory processes, and while the WRAML2 and the TOMAL-2 are sensitive to such functional interference, they cannot reveal the source on their own. Thus some knowledge of personality and related matters will be useful at times, and instruments such as the *Revised Children's Manifest Anxiety Scale–Second Edition* (Reynolds & Richmond, 2008), the *Self-Report of Personality, Child and Adolescent Forms* (Reynolds & Kamphaus, 2004), the *MMPI-A* (Butcher et al., 1992), the *MMPI-2* (Butcher, et al., 1989), the *Adult Manifest Anxiety Scale* (Reynolds, Richmond, & Lowe, 2003a), the *Elderly Anxiety Scale* (Reynolds, Richmond, & Lowe, 2003b), and the *Clinical Assessment Scales for the Elderly* (Reynolds & Bigler, 2001) might prove useful as adjuncts in particular cases.

Clinicians should also be aware of the psychometric limitations of any scale chosen for use. Although carefully and broadly standardized in the United States, the verbal sections of the WRAML2 and the TOMAL-2 would not be appropriate for non-English–speaking populations. Floor and ceiling effects are evident at some ages and these are discussed in the following chapters in the context of each respective memory battery. These are important considerations and should not be overlooked. Attention to error in test scores is also important. The WRAML2 and the TOMAL-2 have very high reliability coefficients, but the scores continue to contain error variance, and rigid cutoffs or major alterations in interpretation based on slight score variations should be avoided. Additionally, although the collection of items on any one subtest or composite is highly reliable, individual test items tend not to be, and examiners should avoid attaching too much significance to individual item performance. Examiners who practice *intelligent testing* (e.g., see Kaufman, 1979; Reynolds, 1987) should avoid such problems in test interpretation. However, no caution can substitute for good psychometric sense, good history taking, a working knowledge of the appropriate psychological literature, and experience working with persons of the developmental level as one's client. When examiners proceed carefully, comprehensive memory assessments have considerable value and offer rich clinical and research information that should benefit our clients as well as our understanding of memory processes.

TEST YOURSELF

1. **The major domains covered in most memory tests are short-term and long-term memory.** True or False?
2. **Many memory researchers consider learning to subsume the construct of memory.** True or False?
3. **Among the most common complaints of individuals following mild head injury are difficulties with memory and attention.** True or False?
4. **The first Binet-Simon intelligence scale included an emphasis on memory skills.** True or False?

(*continued*)

5. **Children diagnosed with a learning disability tend to have a "typical" profile of memory deficits.** True or False?
6. **Memory evaluation is nearly always included by psychiatrists and other physicians when conducting a mental status exam.** True or False?
7. **Hippocampal formations play a major role in distributing information into long-term storage.** True or False?
8. **The amygdala, a component of the limbic system, deals primarily with affect and plays a minor or no role in memory formation.** True or False?
9. ***Anterograde amnesia* is a term related to difficulties establishing new memories.** True or False?
10. **Attention is a precursor to memory formation.** True or False?
11. **Poor performance on multiple sections of a comprehensive memory battery such as the WRAML2 or TOMAL-2 proves some kind of memory impairment in the client.** True or False?
12. **Adding supplemental assessment of personality components often "muddies the water" when attempting to interpret memory test performance and so is discouraged in most adult cases.** True or False?
13. **Both the WRAML2 and the TOMAL-2 emphasize assessment of retrograde amnesia.** True or False?
14. **Alexander Luria was a principal force in the development of psychometrically sound memory assessment measures.** True or False?
15. **The case of HM provided support for the notion that the long-term memory of past events could be erased if certain parts of the cortex were damaged.** True or False?

Answers: 1. False; 2. True; 3. True; 4. True; 5. False; 6. True; 7. True; 8. True; 9. True; 10. True; 11. False; 12. False; 13. False; 14, False; 15, False