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Essentials
of Executive Functions Assessment

George McCloskey
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In the Essentials of Psychological Assessment series, we have attempted to provide the reader with books that will deliver key practical information in the most efficient and accessible style. The series features instruments in a variety of domains, such as cognition, personality, education, and neuropsychology. For the experienced clinician, books in the series will offer a concise yet thorough way to master utilization of the continuously evolving supply of new and revised instruments, as well as a convenient method for keeping up to date on the tried-and-true measures. The novice will find here a prioritized assembly of all the information and techniques that must be at one’s fingertips to begin the complicated process of individual psychological diagnosis.

Wherever feasible, visual shortcuts to highlight key points are utilized alongside systematic, step-by-step guidelines. Chapters are focused and succinct. Topics are targeted for an easy understanding of the essentials of administration, scoring, interpretation, and clinical application. Theory and research are continually woven into the fabric of each book, but always to enhance clinical inference, never to sidetrack or overwhelm. We have long been advocates of “intelligent” testing—the notion that a profile of test scores is meaningless unless it is brought to life by the clinical observations and astute detective work of knowledgeable examiners. Test profiles must be used to make a difference in the child’s or adult’s life, or why bother to test? We want this series to help our readers become the best intelligent testers they can be.

The contents of this book represent a state-of-the-art approach to the assessment of executive functions based on a comprehensive theoretical model developed by the lead author. In his efforts to understand executive functions and how to assess them, Dr. McCloskey has researched a broad array of specialty fields to craft a comprehensive model to serve as a guide for assessment practices. The development of such a theory was deemed necessary as the constructs to be assessed must be clearly defined before valid assessment procedures can be specified.
Although the behavior rating scales currently available for the assessment of executive functions touch on a broader range of executive-function dimensions, they do not provide full coverage of the comprehensive model and have their own set of methodological limitations.

Considering the current state of the art in the assessment of executive functions, McCloskey and Perkins have gone well beyond these current practices to provide a comprehensive assessment framework that places equal emphasis on a wide variety of techniques for assessing executive functions, including clinical interviews of parents, teachers, and students; formal and informal approaches to interpretation of individually administered norm-referenced assessment; and formal and informal approaches to the interpretation of behavior rating-scale results, records reviews, and behavior observations. This book introduces a number of unique methods and techniques, such as including the use of cascading production analyses of norm-referenced measures and the use of implicit measures of executive functions.

Because of the need to construct a comprehensive theory of executive functions to guide assessment, the book devotes the first three chapters to defining executive functions, discussing how executive functions are inextricably interwoven into the structure of multiple psychological assessment constructs, and constructing a multidimensional framework for the assessment of executive functions. The next four chapters discuss specific approaches to executive function assessment in the order in which they are typically encountered in the natural progression of a psychological evaluation. The primary emphasis is on the use of the BRIEF—the only norm-referenced rating scale currently available for the specific purpose of obtaining behavior ratings from children and their parents and teachers. The book includes a CD-ROM that provides tools for enhancing assessment efforts and samples of assessment reports. The breadth and depth of content provided in this book offer clinicians a cutting-edge perspective on the assessment of the executive functions of child and adolescent clients that is sure to enhance their assessment skills and promote best practices.

Alan S. Kaufman, PhD, and Nadeen L. Kaufman, EdD, Series Editors

Yale Child Study Center, School of Medicine
My sincerest thanks are offered to the many individuals who helped make this book a reality, especially the following:

—Dr. Alan Kaufman, who invited me to write this book for the series and who has offered me encouragement and invaluable support not just throughout the preparation of this manuscript but also throughout my entire career as a psychologist. In 1979, before meeting Dr. Kaufman, his book *Intelligent Testing with the WISC-R* offered me the first glimpses of how to apply concepts from cognitive psychology and neuropsychology to the clinical practice of school psychology. A few short years later, Dr. Kaufman welcomed me into the AGS work community with an open mind and shared with me many insights into test development. Since my departure from AGS, Dr. Kaufman has continued to share his knowledge and support over many decades, and for that I am truly thankful.

—The late Dr. Edith Kaplan, who provided me with many opportunities to learn from her vast knowledge and insights about executive functions, to collaborate on workshop presentations, and to experience her generosity of spirit and her friendship.

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the first draft of this book, and provided invaluable feedback and encouragement.

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—The children with whom I have worked over the years and their parents, who placed trust and faith in my ability to help improve the educational experiences of their children and the quality of life for all family members.

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—GM

My sincerest thanks go to Andy Perkins: For his continued love, enduring patience, and steadfast encouragement and to Dr. George McCloskey: for his generosity in sharing his considerable knowledge about executive function use and disuse in children, for his confidence in my professional expertise, and for his friendship.

—LAP
Chapter One

A MULTIDIMENSIONAL MODEL OF EXECUTIVE FUNCTIONS

INTRODUCTION

This introductory chapter offers a multidimensional definition of executive functions and a discussion of several topics related to executive functions development and use. These discussions are important for developing a common understanding of the authors’ theoretical perspective on the multidimensional construct of executive functions and the assessment concepts and methods that are discussed in detail in the remainder of this book.

WHAT ARE EXECUTIVE FUNCTIONS?

Although the term executive functions has been in use for several decades now, there is great variation in how the construct has been defined (Jurado & Roselli, 2007). Rapid Reference 1.1 lists elements of executive functions definitions offered by various authors in the fields of cognitive psychology, neuropsychology, neuroscience, human development, and education. The diversity of definitions presents a challenge for authors attempting to write a book on the assessment of executive functions. Effective assessment of a psychological construct hinges on effective operational definition of the construct to be assessed (Anastasi & Urbina, 2009; Kline, 2000; McDonald, 1999; Nunnaly & Bernstein, 1994). How then does one accomplish the feat of operational definition when such diversity of opinion exists about exactly what it is that is to be measured?

To resolve the predicament arising from a plethora of definitions, the authors of this book chose to provide a widely inclusive multidimensional definition in the form of a comprehensive theoretical model of executive functions specifying how they are manifested in daily functioning. To be effectively comprehensive in nature and to form an overarching framework for the assessment of executive functions, the theoretical model needed to incorporate as many as possible of the salient elements of the various definitions listed in Rapid Reference 1.1.
### Definitions/Elements of Executive Functions From the Professional Literature

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<th>Definitions of Executive Functions and/or Cognitive Constructs Subsumed in Definitions</th>
<th>Source</th>
<th>Holarchical Multidimensional Model Component</th>
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<tbody>
<tr>
<td>Shifting, updating, inhibition</td>
<td>Miyake, Friedman, Emerson, Witzki, and Howarter (2000)</td>
<td>Self-Regulation (Shift, Monitor; Correct, Inhibit)</td>
</tr>
<tr>
<td>Task analysis, strategy selection, and strategy monitoring</td>
<td>Borkowski and Burke (1996)</td>
<td>Self-Regulation (Analyze, Gauge, Decide, Monitor; Correct)</td>
</tr>
<tr>
<td>Control processes involving initiating, sustaining, inhibiting, stopping, shifting, anticipating, planning, efficiency and productivity; emotional as well as cognitive</td>
<td>Denckla (1996)</td>
<td>Self-Regulation (Initiate, Sustain, Inhibit, Stop, Interrupt, Shift, Anticipate, Plan, Execute)</td>
</tr>
<tr>
<td>“The executive functions are a collection of processes that are responsible for guiding, directing, and managing cognitive, emotional, and behavioral functions, particularly during active, novel problem solving.” (p. 1)</td>
<td>Gioia, Isquith, Guy, and Kenworthy (1996)</td>
<td>Self-Determination</td>
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<td>“The executive functions can be conceptualized as having four components: (1) volition; (2) planning; (3) purposive action; and (4) effective performance. Each involves a distinctive set of activity-related behaviors. All are necessary for appropriate, socially responsible, and effectively self-serving adult conduct.” (p. 611)</td>
<td>Lezak, Howieson, Loring, Hannay, and Fischer (2004)</td>
<td>Self-Generation</td>
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<td>The central executive coordinates the processing of information by the phonological loop and the visualspatial sketchpad.</td>
<td>Baddeley and Hitch (1974)</td>
<td>Self-Regulation (Hold, Manipulate, Store)</td>
</tr>
<tr>
<td>Definitions of Executive Functions and/or Cognitive Constructs Subsumed in Definitions</td>
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<td>Holarchical Multidimensional Model Component</td>
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<td>Supervisory attentional system</td>
<td>Norman and Shallice (1985)</td>
<td>Self-Regulation (Focus/Select, Sustain)</td>
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<td>Attentional control; cognitive flexibility; goal setting</td>
<td>Anderson, Northam, Hendy, and Wrenall (2001)</td>
<td>Self-Regulation (Focus/Select, Sustain, Flexible)</td>
</tr>
<tr>
<td>Flexibility of thinking; inhibition; problem-solving; planning; impulse control; concept formation; abstract thinking; creativity</td>
<td>Delis, Kaplan, and Kramer (2001)</td>
<td>Self-Regulation (Flexible, Inhibit, Generate, Associate, Plan, Modulate)</td>
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<td>Purposefully coordinating and organizing behaviors; reflecting on and analyzing the success of generated strategies</td>
<td>Banich (2004)</td>
<td>Self-Regulation (Organize, Analyze, Evaluate/Compare, Monitor)</td>
</tr>
<tr>
<td>Self-regulation; set maintenance; selective inhibition of verbal and nonverbal responding; cognitive flexibility; planning; prioritizing; organizing time and space; output efficiency</td>
<td>Harris et al. (1995)</td>
<td>Self-Regulation (Sustain, Inhibit, Flexible, Plan, Evaluate/Compare, Analyze, Organize, Sense Time, Estimate Time, Execute, Monitor, Correct, Pace)</td>
</tr>
<tr>
<td>Selecting, monitoring, task analyzing, and revising strategies; planning, reflecting on plans; decision-making</td>
<td>Borkowski and Muthukrishna (1992)</td>
<td>Self-Regulation (Focus/Select, Monitor, Analyze, Gauge, Evaluate/Compare, Correct, Decide)</td>
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<tr>
<td>“Executive functions are defined as psychological processes that have the purpose of: Controlling implementation of activation-inhibition response sequences . . . That is guided by diverse neural representations (verbal rules, biological needs, somatic states, emotions, goals, mental models) . . .”</td>
<td>Eslinger (1996)</td>
<td>Self-Regulation (Initiate, Energize, Inhibit, Balance)</td>
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<td>Self-Determination</td>
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<td>Arenas of Involvement (Intrapersonal, Interpersonal, Environment, Academic/Symbol System)</td>
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(continued)
Definitions of Executive Functions and/or Cognitive Constructs Subsumed in Definitions | Source | Holarchical Multidimensional Model Component
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For the purpose of meeting a balance of immediate, situational, short-term, and long-term future goals . . . That span physical-environmental, cognitive, behavioral, emotional, and social spheres.” (p. 381) | Christoff and Gabrieli (2000) | Multiple EFs, Differential Internal (Intrapersonal) vs. External (Interpersonal, Environment, Academic/Symbol System) expression of EFs Levels of Executive Control (viewed hierarchically rather than holarchically)

“More generally, approaching the prefrontal cortex with the assumption of heterogeneity of function and viewing it as a region subserving multiple and differently localized processes appears to be a beneficial approach toward identifying neurally plausible component processes of complex cognition. In particular, the regional distinction proposed here suggests that self referential or introspectively oriented mental activity may be qualitatively different from externally oriented mental activity concentrated on externally generated information. In view of the types of functional distinctions that have been proposed to hold within the human prefrontal cortex, it appears that different prefrontal subregions are best distinguished by viewing them as the components of a hierarchically organized system. Consequently, the general principle according to which the prefrontal cortex is organized may be not so much that of regional dissociations as that of a hierarchical organization.” (p. 183) | Royall et al. (2002) | Self-Regulation (Planning, Initiation, Sequencing, Monitoring) EF levels (Self-Determination vs. Self-Regulation)

“The executive functions” broadly encompass a set of cognitive skills that are responsible for the planning, initiation, sequencing, and monitoring of complex goal-directed behavior. Although a coherent framework of executive control has yet to be developed, two central themes are emerging.

The first theme associates ECF with specific higher cognitive functions such as insight, will, abstraction, and judgment, which are mostly dependent on the frontal lobes.
This view implies that, like memory or language, the executive cognitive functions are acquired skills that can be directly measured. ECF impairment results in the loss of these capacities.

The second theme emphasizes the cybernetic (from the Greek kybernetes, meaning ‘pilot’’) aspects of executive function. Executive functions control the execution of complex activities. This view implies first that ECF interacts with nonexecutive processes, and second that ECF impairment is made visible only via the disorganized operations of nonexecutive domains. The cybernetic view of frontal function is not necessarily incompatible with the older emphasis on higher cognitive abilities, but it does bring a new emphasis on the dynamic interactions between frontal control systems and the processes they interact with.” (p. 378)

“Many of the models of brain functioning have a hierarchical component to them, and we have postulated such a model for self-awareness. . . . This model has several properties: (1) There are four operational levels; arousal-attention; perceptual-motor; executive mediation; self-awareness. (2) Each operational level feeds forward to higher levels, providing a tentative digest of the analyses and associations within that level. (3) Each operational level also feeds backward to lower levels to modulate, bias, constrain or facilitate the analyses and operations that will occur. (4) Direct contact with the external environment is restricted to the perceptual-motor level. (5) The two highest levels are instantiated in frontal lobes. The executive mediation level is predominantly localized to ventrolateral and dorsolateral frontal regions. It incorporates action, planning, inhibitions, and facilitation of parietotemporal association cortices and working memory capacities.

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<td>This view implies that, like memory or language, the executive cognitive functions are acquired skills that can be directly measured. ECF impairment results in the loss of these capacities.</td>
<td>Stuss and Alexander (2000)</td>
<td>Multi-Level Model of Executive Control</td>
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<td>Stuss and Alexander (2000)</td>
<td>Self-Regulation (Perceptual-Motor Level)</td>
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<td>Stuss and Alexander (2000)</td>
<td>Self-Awareness</td>
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<td>Stuss and Alexander (2000)</td>
<td>Discussion of mechanisms of EF interaction with domains of functioning</td>
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### Definitions of Executive Functions and/or Cognitive Constructs Subsumed in Definitions

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<td>Shimamura (2002)</td>
<td>Self-Regulation (Retrieve)</td>
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<td>Neisser (1967)</td>
<td>Self-Determination</td>
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</table>

Open and closed neural loops through basal ganglia and cerebellum provide neural space for unfolding complex plans and for learning frequently used plans. (6) Self-awareness emerges from convergence of emotional states and memory—not simply explicit remote memory of experiences or explicit semantic knowledge—but memory of abstract mental states that allow construction of expectancy and thus memory for the future. Human consciousness is an unstable template of experience and emotion.” (p. 295)

“With respect to memory retrieval, strategic searches of either semantic or episodic memory place heavy demands on selecting, maintaining, updating, and rerouting information processing. It is likely that different prefrontal regions control different aspects of memory. Thus, control of semantic representations will likely involve prefrontal regions that are different from those involved in control of episodic representations.” (p. 218)

The superior part of the dorsolateral prefrontal cortex plays a role in voluntary control of visual processing.

During the first 2–3 months of life, development of connections between the prefrontal cortex and the ociculomotor system and the occipital lobes enables infants to begin to be able to choose where to look and what to look at.

“It now seems possible that there is an escape from the regress that formerly seemed infinite. As recently as a generation ago, processes of control had to be thought of as homunculi, because man was the only known model of an executive agent. Today, the stored-program computer has provided us with an alternative possibility, in the form of the executive routine. This is a concept that may be of considerable use to psychology.
Definitions of Executive Functions and/or Cognitive Constructs Subsumed in Definitions | Source | Holarchical Multidimensional Model Component
--- | --- | ---
...In other situations, however, the choice between register A and register B may depend on a complicated set of conditions, which must be evaluated by a separate subroutine called ‘the executive.’ Common practice is to make all subroutines end by transferring control to the executive, which then decides what to do next in each case. One might well say that the executive ‘uses’ the other routines, which are ‘subordinate’ to it. Some programs may even have a hierarchical structure, in which routines at one level can call those which are ‘lower’ and are themselves called by others which are ‘higher.’ However, the regress of control is not infinite: there is a ‘highest,’ or executive routine which is not used by anything else.

Note that the executive is in no way a programmulus, or miniature of the entire program. It does not carry out the tests or the searches or the constructions which are the tasks or the subroutines, and it does not include the stored information which the subroutines use. Indeed, the executive may take only a small fraction of the computing time and space allotted to the program as a whole, and it need not contain any very sophisticated processes. Although there is a real sense in which it ‘uses’ the rest of the program and the stored information, this creates no philosophical difficulties; it is not using itself. (As a matter of fact, some programs do have so-called recursive subroutines which use themselves).…

...the use of a concept borrowed from computer programming does not imply that existing ‘computer models’ are satisfactory from a psychological point of view. In general, they are not. One of their most serious inadequacies becomes particularly apparent in the present context. The executive routine of a computer program must be established by the programmer

(continued)
Consistent with the common thread throughout the defining literature, the term executive functions can be viewed as an overarching developmental cognitive neuropsychological construct that is used to represent a set of neural mechanisms that are responsible for cueing, directing, and coordinating multiple aspects of perception, emotion, cognition, and action (Gioia, Isquith, Guy, & Kenworthy, 1996; McCloskey, Perkins, & Van Divner, 2009; Stuss & Alexander, 2000).

The operational definition of executive functions that guides the discussion of the assessment practices in this book is based on six interconnected concepts (McCloskey et al., 2009):

1. Executive functions are multiple in nature; they do not represent a single, unitary trait;
2. Executive functions are directive in nature, that is, they are mental constructs that are responsible for cueing and directing the use of other mental constructs;
3. Executive functions cue and direct mental functioning differentially within four broad construct domains: perception, emotion, cognition, and action;
4. Executive functions use can vary greatly across four arenas of involvement: intrapersonal, interpersonal, environment, and symbol system use;

5. Executive functions begin development very early in childhood and continue to develop at least into the third decade of life and most likely throughout the life span, and

6. The use of executive functions is reflected in the activation of neural networks within various areas of the frontal lobes.

Although the term executive functions is becoming more readily recognized by professionals and laypersons, the general metaphorical comparison of executive functions to the CEO of the brain or the conductor of the brain’s orchestra (Brown, 2006; Gioia, Isquith, & Guy, 2001; Goldberg, 2001; Wasserstein & Lynn, 2001) represents an oversimplification of the concept that can lead to inadequate assessment efforts and a reduction in the construct’s clinical utility. In order to understand and effectively assess executive functions, it is important not to think of executive functions as a unitary mental construct. Indeed, Martha Denckla’s (1996) warning not to turn executive functions into the neuropsychologists’ “g” (i.e., a singular, all-encompassing construct) is axiomatic to developing a clinically viable perspective on defining and assessing executive functions. Rapid Reference 1.2 provides more detailed discussion of executive functions as a set of interrelated directive capacities. As discussed in Rapid Reference 1.2, executive functions are best viewed as constituting a collection of “co-conductors” or section leaders, each responsible for a separate aspect of the overall production of the orchestra while working—ideally—in a highly coordinated manner with fellow co-conductors to ensure the desired outcomes.
The Co-Conductor Concept of Executive Functions

As the term implies, executive functions is a concept that applies to multiple cognitive constructs rather than a single, unitary construct. Some discussions of executive functions, however, such as Goldberg’s (2001) reference to executive functions as “the ‘S’ (for smart) factor,” might unintentionally lead one to think of executive functions as a unitary, global mental capacity. Goldberg along with others (Brown, 2006; Gioia, Isquith, & Guy, 2001; Goldberg, 2001; Wasserstein & Lynn, 2001) get snared in the executive functions as a “g” conceptual trap by using the popular orchestra conductor metaphor as an analogy for the relationship between executive functions and the various other mental constructs they direct (see Figure RR1.2A). The orchestra conductor metaphor gives the (usually unintended) impression that the term executive functions defines a singular capacity for cognitive control that is responsible for directing all thought and behavior. Much closer to the current neurocognitive conceptions of executive functions (Berninger & Richards, 2002; Delis et al., 2001; Kaplan 1988; McCloskey et al., 2009; Stuss & Alexander, 2000) is the metaphor of executive functions as a collection of numerous “co-conductors” or “section leaders” each with a highly specific directive role in the overall performance of the orchestra, but each working—ideally—in a highly collaborative manner with all of the other co-conductors, as shown in Figure RR1.2B.

Stuss and Alexander (2000) addressed the problem presented by the orchestra metaphor, stating: “We emphasize that there are specific processes related to different brain regions within the frontal lobes. There is no frontal homunculus, no unitary executive function. Rather, there are distinct processes that do converge on a general concept of control functions. The idea

Figure RR1.2A Visual diagram representing executive functions as the singular conductor of the brain’s orchestra (i.e., executive functions as “g”).

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of a supervisory system is very applicable, if the emphasis is on a system constructed of multiple parts. From a clinical viewpoint, the position that there is no homunculus suggests that there is not a single frontal lobe syndrome with point-to-point correspondence to a homunculus. While a generally consistent frontal lobe syndrome can be found in some patients, this syndrome label describes patients with extensive damage to the frontal lobes often late after injury" (p. 291).

Consistent with the assertions of Stuss and Alexander and other brain researchers (Christoff & Gabrieli, 2000; Denckla, 1996; Pennington, 1997; Posner & Rothbart, 2007; Royall et al., 2002), executive functions are most aptly

(continued)
characterized as a set of multiple mental constructs that appear to be responsible for cueing, directing, and coordinating multiple aspects of perception, emotion, cognition, and action (Gioia, Isquith, Guy, & Kenworthy, 1996; McCloskey et al., 2009). From this perspective, executive functions are seen only as directive processes. They issue or relay commands that engage other mental constructs to carry out those commands; they do not carry out the commands themselves. Executive functions are not the mental mechanisms we use to perceive, feel, think, and act. Instead, they are the mental mechanisms that direct or cue the engagement and use of other mental mechanisms that are used to perceive, feel, think, and act.

As a collection of directive capacities, executive functions cue and coordinate the use of other mental constructs such as reasoning, language, and visuospatial representation within the context of memory time frames. Figure RRI.2C depicts how a selected subset of five independent but interrelated self-regulation executive functions can be involved in an integrated manner to cue and direct the use of a single mental capacity such as the cognitive subdomain of reasoning with verbal information. Expanding on the concept illustrated in Figure RRI.2C, the diagram in Figure RRI.2D depicts interconnections between multiple self-regulation level executive functions (to be discussed later in this chapter) and four general domains of functioning. The single connections from each self-regulation level executive function to each domain of functioning, and even the multiple interconnections of every executive function with every other executive function, really represent an oversimplification of the neural interconnectivity involved. Rather, there are

**Figure RRI.2C Neural network diagram illustrating connections between five self-regulation executive functions and one specific ability within the cognitive domain of functioning.**

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multiple connective neural pathways between each executive function and each of the various subdomains within each of the four very general domains of functioning shown in the diagram as well as multiple pathways between each executive function depending on which executive functions and which subdomains of functioning are being engaged at a given point in time. Figure RR1.2E visually
depicts the concept of the differentiated direction of multiple cognitive subdomains by a single self-regulation executive function. To begin to approximate the likely number of unique connections within the Cognitive Domain, one need envision connections from each of at least 32 self-regulation level executive functions to at least each of the 10 subdomains listed in Figure RR1.2E, and then multiply that number of connections by the four arenas of involvement. The resulting 1,280 connections would be the extreme lower bound estimate for the actual number of connections, with room for many more distinctions of additional self-regulation level executive functions and additional cognitive subdomains.

The concept of independent but coordinated processing is important in understanding how executive functions direct and affect perception, emotion, thought, and action. Because executive functions manifest through multiple neural control circuits, there is no guarantee that if a child exhibits one well-developed executive function neural circuit, all executive functions circuits will be well-developed in that child. Similarly, even though a child might have many well-developed executive functions, the interconnections between some of these executive functions might not be as well-developed as others, resulting in less coordinated direction and control when one interrelated circuit is activated, but not when a different interrelated circuit is activated. While certain clinical disorders may show specific, typical patterns of executive function weaknesses or deficiencies, any person can exhibit strengths and/or weaknesses in any one or more of the different executive functions at any given point in time.

Assessment of executive functions, therefore, requires a multidimensional approach to identify the specific constellation of executive functions strengths and weaknesses for a given child. The level of specificity of strengths and weaknesses possible through assessment, however, will never fully reflect the client’s actual pattern of neural connectivity, but it can highlight the most important executive function strengths and weaknesses in a manner that makes it possible to develop a plan for further development and improvement.

The comprehensive multidimensional model of executive functions used as a framework for assessment as described in this book has been presented in detail in other sources (McCloskey, 2004; McCloskey et al., 2009). This holarchical, developmental model offers a set of interrelated concepts to describe the nature of executive functions. The executive function components of the model are shown in Figure 1.1. Rapid Reference 1.3 presents the conceptual underpinnings of the model. Rapid Reference 1.4 describes 32 self-regulation level executive functions that form the core of the model and that are a major focus of executive functions assessment.
The Holarchical Model of Executive Functions is based on an integration of the following concepts:

- **Five Tiers of Executive Function Control**
- **32 Separate Self-Regulation Executive Functions within the Self-Regulation Level**
- **Four Broad Domain of Functioning with Multiple Subdomains within each**
- **Four Arenas of Involvement**

**Five Tiers of Executive Function Control**

**Self-Activation**

The self-activation tier represents the neural processes involved in the awakening or “ramping up” of executive functions after sleep or other prolonged nonconscious states (Balkin et al., 2002). During the self-activation process,
less than optimal state of perceiving, feeling, thinking and acting is experienced; this suboptimal state is referred to as sleep inertia. This state of sleep inertia typically resolves shortly after awakening (i.e., approximately 5 to 20 minutes). As sleep inertia fades, access to upper level self-control processes becomes possible. The self-activation level represents the gateway to self-control at the other levels.

**Self-Regulation**

As the self-activation process unfolds, a person has increasing degrees of access to the self-regulation-tier of executive functions. The self-regulation tier is comprised of multiple executive functions responsible for cueing, directing, and coordinating moment-to-moment functioning within the various subdomains of the four broad domains of Perception, Emotion, Thought, and Action. Self-regulation executive functions are responsible for the aspects of self-control that enable a person to direct daily functioning. The model of executive functions presented here identifies 32 self-regulation executive functions that can be used individually and in varying combinations to direct and cue perception, emotion, cognition, and action most of the time. Rapid Reference 1.4 provides a brief description of the 32 self-regulation executive functions specified in the model.

The 32 self-regulation executive functions described in Rapid Reference 1.4 are distinct from one another and are not uniform in their degree of control capacity, that is a child’s effectiveness with each of these self-regulation level executive functions can vary greatly. For example, a person might be very effective at using the Focus/Select cue to direct attention to a stimulus, but be very ineffective in the use of the Sustain cue when it would be advantageous to maintain attention to the stimulus for an extended period of time.

**Self-Realization and Self-Determination**

At the third tier of this model, self-control processes extend beyond the basic self-regulation executive functions that govern day-to-day functioning. Executive functions at this tier are engaged in directing the development of a consistent self-image and goals and plans that extend beyond the immediate moment. The two subdomains distinguished at this level—self-realization and self-determination—are described next.

Self-Realization. Being able to direct, cue, and coordinate the use of self-regulation executive functions does not require a person to be consciously aware of what they are doing or how they are doing it. It is possible to nonconsciously make use of executive functions to self-regulate perceptions, feelings, thoughts, and actions without engaging in any conscious form of self-realization. The activation of separate neural circuits routed through specific portions of the frontal lobes is necessary for a person to be aware of themselves in a reflective manner. Such self-reflective processes enable a person to become aware of their