

HOW THE Brain Learns

FOURTH EDITION

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Contents

PREFACE TO THE FOURTH EDITION	ix
ABOUT THE AUTHOR	x
INTRODUCTION	1
Looking Inside the Brain	1
Types of Brain Imaging	2
Implications for Teaching	4
Some Important Findings	5
Why This Book Can Help Improve Teaching and Learning	6
Chapter Contents	7
Who Should Use This Book?	8
Try It Yourself—Do Action Research	9
What's Coming Up?	10
CHAPTER 1 – Basic Brain Facts	15
Some Exterior Parts of the Brain	16
Lobes of the Brain	16
Motor Cortex and Somatosensory Cortex	18
Some Interior Parts of the Brain	18
Brain Stem	18
The Limbic System	18
Cerebrum	20
Cerebellum	20
Brain Cells	21
Brain Fuel	23
Neuron Development in Children	24
Windows of Opportunity	25
The Brain as a Novelty Seeker	29
Environmental Factors That Enhance Novelty	29
What's Coming Up?	35
CHAPTER 2 – How the Brain Processes Information	41
The Information Processing Model	42
Origins of the Model	42

Usefulness of the Model	42
Limitations of the Model	43
Inadequacy of the Computer Model	44
The Senses	45
Sensory Register	45
Short-Term Memory	46
Long-Term Storage	55
The Cognitive Belief System	56
Self-Concept	56
Learning Profiles (Styles)	58
What's Coming Up?	60
CHAPTER 3 – Memory, Retention, and Learning	82
How Memory Forms	83
The Temporary Stimulus	84
Forming the Memory	84
Stages and Types of Memory	86
Stages of Memory	86
Types of Memory	86
Emotional Memory	89
Learning and Retention	91
Factors Affecting Retention of Learning	91
Rehearsal	92
Retention During a Learning Episode	94
Implications for Teaching	95
Learning Motor Skills	102
Brain Activity During Motor Skill Acquisition	102
Does Practice Make Perfect?	103
Daily Biological Rhythms Affect Teaching and Learning	106
Circadian Rhythms	106
The Importance of Sleep in Learning and Memory	107
Intelligence and Retrieval	110
Intelligence	110
Retrieval	113
Chunking	116
Forgetting	120
What's Coming Up?	124
CHAPTER 4 – The Power of Transfer	143
What Is Transfer?	144
Transfer During Learning	144
Types of Transfer	145
Transfer of Learning	146
Teaching for Transfer	147
Factors Affecting Transfer	149

Teaching Methods	154
Transfer and Constructivism	157
English Language Learners (ELLs) and Transfer	157
Technology and Transfer	158
Additional Thoughts About Transfer	158
What's Coming Up?	159
CHAPTER 5 – Brain Organization and Learning	175
Brain Lateralization	176
Left and Right Hemisphere Processing (Laterality)	176
What Causes Specialization?	178
Specialization Does Not Mean Exclusivity	179
The Gender Connection	180
Schools and Brain Organization	185
Spoken Language Specialization	187
Learning Spoken Language	188
Learning a Second Language	191
Learning to Read	192
Is Reading a Natural Ability?	192
Neural Systems Involved in Reading	193
Skills Involved in Reading	194
Problems in Learning to Read	196
Implications for Teaching Reading	198
What's Coming Up?	198
CHAPTER 6 – The Brain and the Arts	216
The Arts Are Basic to the Human Experience	216
Why Teach the Arts?	217
The Arts and the Young Brain	218
The Arts Develop Cognitive Growth	218
The Arts and Creativity	220
The Sciences Need the Arts	221
Impact of the Arts on Student Learning and Behavior	222
Arts Education and Arts Integration	222
Other Areas of Impact	222
Music	224
Is Music Inborn?	224
Effects of Listening to Music Versus Creating	
Instrumental Music	225
How the Brain Listens to Music	226
The Benefits of Listening to Music	227
Creating Music	228
Benefits of Creating Music	229
Creating Music Benefits Memory	230
Does Creating Music Affect Ability in Other Subjects?	230

Music and Reading	233
Student Attitudes Toward Music in the Schools	234
The Visual Arts	234
Imagery	234
Research on Visual Arts and Learning	236
Movement	237
Movement and the Brain	237
Implications for Schools	238
What's Coming Up?	240
CHAPTER 7 – Thinking Skills and Learning	250
Characteristics of Human Thinking	250
Types of Thinking	251
Thinking as a Representational System	251
Thinking and Emotion	252
The Dimensions of Human Thinking	252
Designing Models	252
Are We Teaching Thinking Skills?	253
Modeling Thinking Skills in the Classroom	254
Revisiting Bloom's Taxonomy of the Cognitive Domain	255
Why Start With This Model?	255
The Model's Structure and Revision	256
Important Characteristics of the Revised Model	260
Cognitive and Emotional Thinking	261
Testing Your Understanding of the Taxonomy	261
The Taxonomy and the Dimensions of Thinking	262
The Critical Difference Between Complexity and Difficulty	263
Curriculum Changes to Accommodate the Taxonomy	265
What's Coming Up?	267
CHAPTER 8 – Putting It All Together	279
Daily Planning	280
General Guidelines	280
Daily Lesson Design	280
Twenty-One Questions to Ask During Lesson Planning	284
Unit Planning	286
Teacher's Work Sample	286
Maintaining Skills for the Future	287
The Building Principal's Role	287
Types of Support Systems	287
Conclusion	289
RESOURCES	292
GLOSSARY	296
REFERENCES	301
INDEX	314

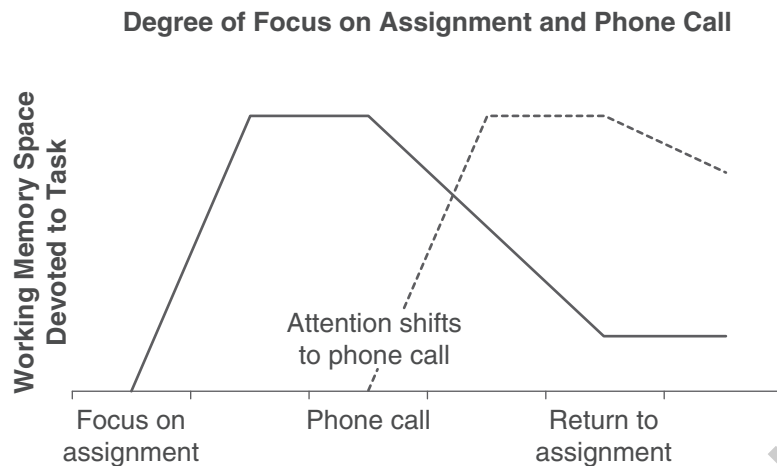


Figure 1.7 When an assignment is interrupted by a phone call, memory resources dedicated to the assignment (solid line) decline, and resources dealing with information from the phone call (dotted line) increase.

and back again to Item A, there is a cognitive loss involved. Figure 1.7 illustrates the process that will unfold in the following example. The solid graph line represents the amount of working memory used to process a homework task, and the dotted graph line represents the amount used to process an incoming phone call. Let us say Jeremy is a high school student who is working on a history assignment and has just spent 10 minutes focusing on understanding the major causes of World War II. The thinking part of his brain is working hard, and a significant amount of working memory is processing this information.

Suddenly, the cell phone rings. It is Jeremy's girlfriend, Donna. As he answers the phone, his brain must disengage from processing history information to recalling the steps to answering and attending to a phone call. Jeremy spends the next six minutes chatting with Donna. During that time, much of the World War II information that Jeremy's working memory was processing begins to fade as it is replaced by information from the phone call. (Working memory has a limited capacity.) When Jeremy returns to the assignment, it is almost like starting all over again. The memory of having worked on the assignment may cause the student to believe that all the information is still in working memory, but much of it is gone. He may even mumble, "OK, where was I?" The task of switching tasks incurs a price (Monk, Trafton, & Boehm-Davis, 2008). Some studies indicate that a person who is interrupted during a task may take up to 50 percent longer to finish the task and make up to 50 percent more errors (Medina, 2008).

Task Switching and Complex Texts. Living in a world where task switching is the norm may be affecting a student's ability to read and concentrate on complex texts. In a 2006 report, the assessment and research firm ACT examined the readiness of high school graduates to tackle the reading required of college texts and technical manuals. The study found that there was no significant difference between the scores of students who were college bound and those who were not in the areas of reading for the main idea, the meaning of words, supporting evidence, generalizations,

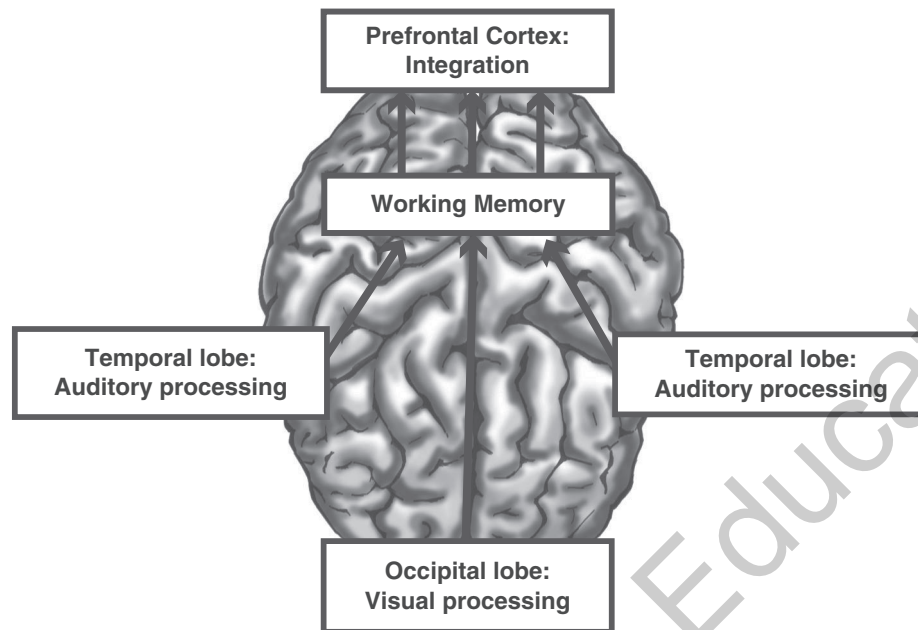


Figure 3.10 The diagram shows how auditory processing in the temporal lobe and visual processing in the occipital lobe are sent on to working memory and then to the prefrontal cortex for integration.

- **Learn by Doing/Practice.** A great deal of research shows that getting immediately involved in new learning—that is, practicing it—enhances the memory of that learning. Very often, practice involves kinesthetic and tactile activities, thereby obtaining more sensory input. Learning by doing also encourages problem-based learning, whereby students get a real-world problem to solve that involves using their new information and skills. The problem-based approach has the added advantage of boosting student motivation when compared to lecture-based instruction because students see how the learning can be used to directly address meaningful problems.
- **Practice and Teaching Others.** We have known for a long time that the best way to learn something well is to prepare to teach it. In other words, whoever explains, learns. This is one of the major components of cooperative learning groups and helps to explain the effectiveness of this instructional technique.

Whoever explains, learns!

Lecture continues to be the most prevalent teaching method in secondary and higher education, despite evidence that it produces the lowest degree of retention for most learners.

No One Teaching Method Is Best. No one teaching method exists that is best for all students all the time. Sometimes, lecture is the appropriate method when a lot of information needs to be

PRACTITIONER'S CORNER

Using Mnemonics to Help Retention

Mnemonics (from the Greek “to remember”) are very useful devices for remembering unrelated information, patterns, or rules. They were developed by the ancient Greeks to help them remember dialogue in plays and for passing information to others when writing was impractical. There are many types of mnemonic schemes. The good news is that ordinary people can greatly improve their memory performance with appropriate strategies and practice (Ericsson, 2003). Here are two strategies that can be easily used in the classroom. Work with students to develop schemes appropriate for the content.

- **Rhyming Mnemonics.** Rhymes are simple yet effective ways to remember rules and patterns. They work because if you forget part of the rhyme or get part of it wrong, the words lose their rhyme or rhythm and signal the error. To retrieve the missing or incorrect part, you start the rhyme over again, and this helps you to relearn it. Have you ever tried to remember the fifth line of a song or poem without starting at the beginning? It is very difficult to do because each line serves as the auditory cue for the next line.

Common examples of rhymes we have learned are “I before e, except after c . . . ,” “Thirty days hath September . . . ,” and “Columbus sailed the ocean blue. . . .” Here are some rhymes that can help students learn information in other areas:

**The Spanish Armada met its fate
In fifteen hundred and eighty-eight.**

**Divorced, beheaded, died;
Divorced, beheaded, survived.**
(the fate of Henry VIII’s six wives, in chronological order)

**The number you are dividing by,
Turn upside down and multiply.**
(the rule for dividing by fractions)

This may seem like a clumsy system, but it works. Make up your own rhyme, alone or with the class, to help you and your students remember more information faster.

- **Reduction Mnemonics.** In this scheme, you reduce a large body of information to a shorter form and use a letter to represent each shortened piece. The letters either are combined to form a real or artificial word or are used to construct a simple sentence. For example, the real

twist your torso to hand it over. If the person asks you to throw the pen, however, you will probably use your right hand because this task is more difficult.

During learning, *both* hemispheres are engaged, processing the information or skill according to their specializations and exchanging the results with the opposite hemisphere through the corpus callosum. So if someone were to toss a pen to you, your likelihood of successfully catching it would increase greatly if you used *both* hands, not just your right (dominant) hand.

Knowing the difference between how the left and right hemispheres process information explains why we succeed with some tasks but not with others, especially when we are trying to do them simultaneously. For instance, most of us can carry on a conversation (left-hemisphere activity) while taking a walk (right-hemisphere and cerebellar activity). In this case, each task is controlled by different hemispheres. However, trying to carry on a conversation on the telephone while talking to someone in the room at the same time is very difficult because these are functions of the same (left) hemisphere and can interfere with each other.

Implications of Specialization for Teachers

Brain specialization may be a contributing factor to an individual's learning profile, although there is little neuroscientific research evidence to date to support this notion. The lack of substantial evidence, however, does not negate the observations that experienced teachers have made of the behaviors students display demonstrating the different ways they interpret their learning. When teachers understand these differences, they plan lessons that address all learning preferences. See the Practitioner's Corner at the end of this chapter on page 199 on teaching to the whole brain.

The Gender Connection

Scientists have known for years that, apart from their different genes, there are structural and developmental as well as performance differences (Table 5.2) between male and female brains. Studies begun in the early 1970s and subsequent studies by other researchers have shown some gender differences in brain characteristics and capabilities. PET scans and fMRIs, for instance, indicate that males and females use different areas of their brains when accomplishing similar tasks (Cahill, 2005; M. Diamond & Hopson, 1998). Let's see what those differences are before we discuss what they mean. Keep in mind that research studies deal with *groups* of males and females. It is not always valid to assign characteristics to a specific person because individuals vary widely from one to another. Furthermore, when there is a difference between two groups (in this case, the genders), we should avoid believing that one group is "better" than the other or that gender is destiny and, thus, the differences cannot be addressed.

Structural and Developmental Differences

- Males have a higher percentage of gray matter (the thin cortex layer containing mostly dendrites) in the left hemisphere than do females. In females, the percentage of gray matter is the same in both hemispheres. However, females have a higher percentage of total gray matter,

6. *Check for Understanding.* This refers to the strategies the teacher will use during the learning episode to verify that the students are accomplishing the learning objective. The check could be in the form of oral discussion, questioning, written quiz, think-pair-share, or any other overt format that yields the necessary data. Depending on the results of these checks, the teacher may decide to provide more opportunities for input, reteach, or move on to new material.
7. *Guided Practice.* During this time, the student is applying the new learning in the presence of the teacher who provides immediate and specific feedback on the accuracy of the learner's practice. Later, the teacher checks any corrections that the student made as a result of feedback.
8. *Closure.* This is the time when the mind of the learner can summarize for itself its perception of what has been learned. The teacher gives specific directions for what the learner should mentally process and provides adequate time to accomplish it. This is usually the last opportunity the learner has to attach sense and meaning to the new

Closure is usually the last opportunity the learner has to attach sense and meaning to new learning.

learning, both of which are critical requirements for retention. Daily closure activities can take many forms, such as using synergy strategies or journal writing. Closure activities for the end of a unit might include writing plays, singing songs, reciting poetry, playing quiz games, and so on.

9. *Independent Practice.* After the teacher believes that the learners have accomplished the objective at the correct level of difficulty and complexity, students try the new learning on their own to enhance retention and develop fluency.

Not every lesson needs every component. The teacher should consider each component and choose those that are relevant to the learning objective and teaching method.

Important Note. Not every lesson needs to include every component. However, the teacher should consider each component and choose those that are relevant to the learning objective and teaching method. For example, when introducing a new major unit of study, the lesson may focus primarily on *objectives* (What do we hope to accomplish?) and *purpose* (Why are we studying this?). On the other hand, a review lesson

before a major test might include more ways of *checking for understanding* and for *guided practice*.

Table 8.1 shows the lesson components that could be used with each teaching method. Table 8.2 shows the lesson components, their purpose, their relationship to the research, and an example from a lesson on teaching the characteristics of suffixes.