It is difficult to overstate the importance of understanding mirror neurons and their function. They may well be central to social learning, imitation, and the cultural transmission of skills and attitudes—perhaps even of the pressed together clusters we call words.

—V. S. Ramachandran, The Tell-Tale Brain: A Neuroscientist’s Quest for What Makes Us Human

Early experience shapes the structure and function of the brain. This reveals the fundamental way in which gene expression is determined by experience.

—Daniel Siegel, The Developing Mind: How Relationships and the Brain Interact to Shape Who We Are

The problem is, when you depend on a substitute for love, you never get enough.

—Louis Cozolino, The Neuroscience of Human Relationship: Attachment and the Developing Social Brain

**BRIEF OVERVIEW**

During the past two decades, major advances in neuroscience have changed our knowledge of the brain and the role it has in mental health and mental illness (Andreasen, 2001). A paradigm shift has taken place from the four previous forces in psychotherapy to one involving the use of neuroscience to inform psychotherapy (Arden, 2010; Rossouw, 2013). It is essentially a paradigm shift from focusing primarily on the so-called talking therapy to emphasizing the therapeutic relationship as an engagement with the whole person, his or her brain/mind, genetics/body, environment, and spirit.

This chapter is written to empower clinicians to use neurobiological information as a psychotherapeutic tool in their armamentarium of interventions. It is designed to shed light on how their work in psychotherapy might change their clients’ very brains. Neuroscience provides either a new framework or an additional way for conceptualizing clients’ problems and presenting issues. It has the capacity and the tools to reveal what is happening in a client’s brain as he or she works with a therapist (Cozolino, 2010). Previously, therapists could only theorize about what might be happening in a client’s brain. Moreover, neuroscience emphasizes...
holistic treatment of individuals, treatment that involves not only their mental health issues but also other factors in their environment that might be impinging on their mental health, such as the effects of poverty on the brains of young children and the influence of trauma in their homes and neighborhood on their being able to learn in school (Grawe, 2007).

This chapter has four basic goals, the first of which is to present a detailed examination of the connection between neuroscience and psychotherapy. Brief historical sketches are provided for several key figures who have connected neuroscience with psychotherapy. These are not the only major contributors to neuroscience and psychotherapy; however, to write a factual account of historical figures in neuroscience and psychotherapy is beyond the scope of this chapter.

A second goal is to provide a framework for neuropsychotherapy based on the principles that have already been established in the broad fields of neuroscience and neuropsychology. This chapter does not attempt to provide a full-blown theory of neuropsychotherapy, primarily because I am not a neuroscientist. Instead, throughout this chapter, the reader will be introduced (a) to various psychologists and medical doctors who are using neuroscientific principles and findings and infusing these findings within their already established psychotherapy frameworks and (b) to psychotherapists who are working on developing a theory of neuropsychotherapy. For the first category of psychotherapists, who infuse neuroscientific principles in their psychotherapy, I refer the reader to consider the work of Eric Kandel (1998, 2005), Louis Cozolino (2010), Daniel Siegel (1999, 2010, 2013), and Rick Hanson (2013). These writers have incorporated neuroscientific principles within their already established psychodynamic approach to therapy.

Additionally, this chapter discusses the work of several individuals who have developed what is termed in the neuroscience literature as brain-based therapies. For example, I present in summary form the work of Bruce Ecker and his colleagues (2012) on coherence therapy, a new theory for psychotherapy that puts recent findings on memory reconsolidation at center stage (Tucker, Hully, & Ticic, 2012). Two other brain-based theories introduced in this chapter are eye movement desensitization and reprocessing (EMDR), developed by Francine Shapiro (2001), and brainspotting, developed by David Grand (2013). “Brainspotting is based on the profound attunement of the therapist with the patient, finding a somatic cue and extinguishing it by down-regulating the amygdala. It isn't just PNS (Parasympathetic Nervous System) activation that is facilitated, it is homeostasis” (Robert Scaer, MD, “The Trauma Spectrum,” cited on the What Is Brain Spotting website https://brainspotting.pro/page/what-brainspotting).

- Brainspotting is a powerful, focused treatment method that works by identifying, processing and releasing core neurophysiological sources of emotional/body pain, trauma, dissociation and a variety of other challenging symptoms.
- A “Brainspot” is the eye position which is related to the energetic/emotional activation of a traumatic/emotionally charged issue within the brain, most likely in the amygdala, the hippocampus, or the orbitofrontal cortex of the limbic system. Located by eye position, paired with externally observed and internally experienced reflexive responses, a Brainspot is actually a physiological subsystem holding emotional experience in memory form. (https://brainspotting.pro/page/what-brainspotting)

The developers of these new brain-based approaches had the fascinating idea that there are brain-based procedures therapists can use to assist clients in actually erasing—not just coping with—painful memories. One does not have to spend the rest of one’s life grappling with the issue of a rejecting parent, sexual abuse, and other traumatic events in one’s life. These authors believe that they have uncovered how the brain circuitry works in memory consolidation as well as in memory reconsolidation and have developed a process of activating a distressing memory, destabilizing it, and reconsolidating a new memory in its place so
that the terrifying memory no longer has its power to create problems for the person.

In presenting a beginning framework for developing a theory of neuropsychotherapy, I consider key concepts such as neuroplasticity, implicit memory, explicit memory, memory reconsolidation, mirror neurons, and right-brain to right-brain therapy. The chapter also examines mental health and illness from a neuroscientific perspective, the role of the neuropsychotherapist, and therapeutic techniques that some neuroscientists use in their clinical practice.

A third goal of this chapter is to explore the concept of cultural neuroscience. What is the impact of our culture on our brains? Are the brains of people raised in an Eastern culture different from those reared in a Western culture? Do cultural values condition people to prefer using the right-brain hemisphere over the left?

Finally, Goal 4 is to present the case study of Justin from a neuropsychotherapy perspective. Because the neuroscientific perspective emphasizes holistic counseling, factors such as Justin's wellness, his diet, the environment in which he lives, and his level of brain development are considered in this case study. Two implicit questions raised in the case study are “What might be helpful for the counselor to know about Justin's developing young brain?” and “What might be the relationship between Justin's impulsive behavior and his adolescent brain development?”

This chapter raises some ethical issues for therapists and helping professionals in general. For instance, does a therapist have an ethical responsibility to learn about brain development? What ethical issues does the neuroscience paradigm have for practicing therapists and counselors? Should psychology, social work, and counseling programs introduce their students to the developments in the neuroscientific revolution, or should they just continue to ignore it and focus primarily on theories of psychotherapy that were created during the 1940s, 1950s, 1960s, and 1970s? Should our professional organizations that credential individuals in the helping professions require that new entrants have competency in neuroscience?

A disclaimer should be made regarding the content of this chapter. For instance, the chapter does not pretend to be an exhaustive examination of the field of neuroscience, and it does not deal with rehabilitation of the brain due to traumatic injury or neurologic injury. It does, however, present a fairly readable introduction to neuroscientific thinking that holds the promise of revolutionizing how psychotherapy is conducted and tested for its efficacy.

MAJOR CONTRIBUTORS ________

The current neuroscientific paradigm is not connected to a single person, and therefore, this section presents three key individuals who have a link with neuroscience and psychotherapy: Sigmund Freud, Donald Hebb, and Eric Kandel. Only a brief description of their contributions is provided.

Sigmund Freud (1856–1939)

When most people think of Sigmund Freud (1856–1939), they think about him as the founder of psychoanalysis and as the person who created a theory of personality development—the id, ego, and superego. Few people know that Freud was a neuroscientist before he became a psychotherapist. He is included as one of the historical figures in neuroscience because of his early work in neurology and because he represents a major link between neuroscience and psychoanalytic psychotherapy. He is also represented as a major contributor because of his work on the unconscious, an important construct in the neuroscientific view of implicit memory.
Freud began his career investigating the central nervous system (Zillmer, Spiers, & Culbertson, 2008). In 1883, Freud worked under Meynert, a neurosurgeon and psychiatrist, and he confined himself to studying the nervous system. For 2 years, Freud concentrated on the medulla of the brain stem, and he published three articles. From 1885 to February 1886, Freud studied with Jean-Martin Charcot, the famous neurologist. In 1891, he published his first book, An Understanding of Aphasia, which got only a tepid reception from scholars (Zillmer et al., 2008).

Freud's psychoanalytic model for personality is loosely related to brain processes (Zillmer et al., 2008) that are at the center of neuroscientific research. For instance, Freud's id, which is based on the pleasure principle, can be conceptualized as developing out of the reptilian brain. The superego is linked with the prefrontal lobe processes that are involved in forming abstract concepts such as morality, guilt, planning, and inhibition. The ego, which is based on the reality principle, can be associated with the complex brain processes in the cortex (Zillmer et al., 2008). In his book On Narcissism (1959), Freud proposed that all ideas in psychology would one day be explained by organic substrates. Freud actually coined the term agnosia, which came from the Ancient Greek word Γνωσία (meaning “ignorance” or “absence of knowledge”) and refers to a loss of ability to recognize objects, persons, and sounds, usually associated with brain injury or neurological illness.

Neuroscience has given psychoanalysis and the psychodynamic perspective in psychotherapy a new resurgence. Regina Palley (2000), a psychiatrist and psychoanalyst, maintains that both the neuroscience of emotion and psychoanalysis center on unconscious mechanisms. While neuroscience emphasizes what one might consider a biological unconscious governed by the rules and constraints of neural circuitry and neuropsychology, psychoanalysis focuses on a psychological unconscious. Both psychoanalysis and neuroscience assert that conscious feelings form only the tip of the iceberg of human experience. The truly meaningful information for most people's lives resides beneath the tip of the iceberg—in the unconscious. Both neuroscience and psychoanalysis emphasize the importance of attachment and the mother–infant feedback loop in which mother and child regulate each other's minds and bodies.

**Donald Hebb (1904–1985)**

*Hebb's Law: Neurons That Fire Together Wire Together*

Donald Hebb was born in Chester, Nova Scotia, Canada, and was raised by parents who were physicians. Although he graduated in 1925 from Dalhousie University with a desire to be a novelist, he decided to choose the more practical field of education and, shortly after graduation, accepted a position as a school principal in the province of Quebec (Brown & Milner, 2003). In 1936, he earned a Ph.D. degree from Harvard in the area of the effects of early visual deprivation on size and brightness perception in the rat. Donald Hebb's contribution was that he made critical discoveries about the brain's wiring. In 1942, Hebb accepted a position at the Yerkes Laboratory of Primate Biology, where he began working on a book that was later published in 1949, *The Organization of Behavior: A Neuropsychological Theory* (Hebb, 1949). In this book, Hebb presented a theory that became known as Hebb's law: Neurons that fire together wire together. Hebb's law explains associative learning in which a simultaneous activation of neuron cells leads to an increase in the synaptic strength
Principle 3: Social or developmental factors can exert actions on the brain to produce mental disorder. Learning-dysfunctional behavior produces alterations in gene expression.

Principle 4: Alterations in gene expression brought on by learning leads to changes in the patterns of neuronal connections.

Principle 5: When psychotherapy is effective, it does so through learning, by producing changes in gene expression that change the strength of synaptic connections and structural changes that change the anatomical pattern of interconnections between nerve cells of the brain.

Kandel's principles sent shock waves through the leaders in the field, who were trying to infuse neuroscientific principles about the brain in their psychotherapy practices.

Eric Kandel (1929–) Eric Richard Kandel was born on November 7, 1929, in Vienna, Austria, the younger of the two sons of Herman Kandel and Charlotte Zimels, who owned a toy store where both worked. In 1939, the Kandels left Austria and moved to Brooklyn, New York, to live with Charlotte's parents. Kandel attended Erasmus Hall High School in Brooklyn. He entered Harvard, majored in 19th- and 20th-century European history and literature, and graduated in 1952. In 1956, he earned his medical degree from New York University's medical school, and in 1956, he married Denise Bystryn. In 2000, Kandel was awarded the Nobel Prize in Physiology or Medicine for his groundbreaking research revealing what happens to the brain when memories are formed. Kandel had conducted studies on the single-cell sea slug Aplysia to learn how nerve cells (neurons) change during learning (Kandel, 2000). His research on the sea slug Aplysia revealed the basis of short-term memory and long-term memory. For more information on Kandel, his history, and the basis for the Nobel Prize, refer to http://www.nobel-prize.org/nobel_prizes/medicine/laureates/2000/kandel-bio.html. The following is a brief paraphrasing of the five principles Kandel mentioned in his 1998 article on neuroscience and psychotherapy.

Kandel's Principles for Neuroscience and Psychotherapy

Principle 1: All mental processes, even the most complex psychological processes, come from operations of the brain. The mind is a range of functions carried out by the brain. Behavioral disorders that characterize psychiatric illness involve disturbances of brain function.

Principle 2: Genes are important determinants of the interconnections between neurons in the brain and the details of their functioning. A person's genetics contributes to the development of major mental illnesses.

Principle 3: Social or developmental factors can exert actions on the brain to produce mental disorder. Learning-dysfunctional behavior produces alterations in gene expression.

Principle 4: Alterations in gene expression brought on by learning leads to changes in the patterns of neuronal connections.

Principle 5: When psychotherapy is effective, it does so through learning, by producing changes in gene expression that change the strength of synaptic connections and structural changes that change the anatomical pattern of interconnections between nerve cells of the brain.

TOWARD A THEORETICAL FRAMEWORK FOR NEUROPSYCHOTHERAPY

This section provides a framework that might be used to formulate a theory of neuropsychotherapy. The term neuropsychotherapy has been used in various ways throughout the literature (Grawe, 2007). One definition is that neuropsychotherapy is an integrative approach to therapy that takes into account the dynamic...
interplay between the mind, body, social interaction, and the environment on a person’s well-being with a focus on neuroscientific research. By understanding the mechanisms of our biology (an in particular our neurology), the processes of our psychology, and the influences of social interaction, it is believed a holistic therapeutic practice can be formulated. (Neuropsychotherapy, Changing Minds. Retrieved from http://www.neuropsychotherapist.com/about/neuropsychotherapy)

In addition, the term neuropsychotherapy has been used to refer to any psychotherapeutic approach that has been informed by neuroscience (Grawe, 2007).

For the most part, however, information about neuropsychotherapy is scattered in diverse books and articles. There is no standard theory of neuropsychotherapy that is generally accepted in the field of psychotherapy—although Klaus Grawe (2007) proposed the beginnings of one such theory before his death. Essentially, neuropsychotherapy advocates promoting therapists’ greater in-depth knowledge of the workings of the brain as well as other features of the human biology to enhance their therapeutic practice, regardless of their theoretical orientation. Neuropsychotherapy seeks to change the brain. As Grawe (2007) has stated,

Neuropsychotherapy aims to change the brain, but it does not directly target primarily the brain but focuses on the life experiences encountered by the person. The brain specializes in the processing of life experiences. Life experiences are meaningful with regard to the needs that are embedded within the brain structures of each human being. Neuropsychotherapy strives to shift the brain into a state that enables these basic needs to be fully satisfied. The best method for improving the health of the brain, then, is to ensure basic need satisfaction. (p. 424)

**KEY CONCEPTS**

Most of the important concepts in neuropsychotherapy are related to the brain, its structures, and its functions. It is important that therapists begin to develop the language of neuroscience and acquire a beginning level of competency in understanding the impact of their words and behaviors on their clients’ brains. This section discusses a number of key concepts that might be included in either a theory of neuropsychotherapy or a practice that uses neuroscientific principles within an established theoretical framework, such as psychodynamic or cognitive-behavioral approaches.

**The Brain**

The brain is a three-pound mass of tissue composed of gray and white matter. It used to be routine to say that the brain consists of 100 billion cells (Zillmer et al., 2008). However, a recent study by Azevedo et al. (2009) has found that an adult male human brain contains “on average 86.1 ± 8.1 billion NeuN-positive cells (‘neurons’) and 84.6 ± 9.8 billion NeuN-negative (‘nonneuronal’) cells” (p. 532), or approximately only 86 billion cells. The brain is the receiver of information from both inside and outside a person. Current neuroscience conceptualizes the brain as a dynamic structure that shapes and can be shaped, that changes and can be changed, and that gets mired down in neural firing patterns but can heal or repair itself to become unstuck.

The brain is a social organ. Our human interpersonal interactions basically shape the construction of our brains (Cozolino, 2010). A person's brain is fundamentally shaped during the attachment process with a primary caregiver. Cozolino (2010) maintains that “there are no single brains” (p. 6), and in making this assertion, he puts attachment constructs and relationships at the heart of the development of both adaptive and maladaptive behaviors in children and adults. The brain is also an organ of adaptation, and its structures are built in interaction with other people and with the environment (Figure 20.1). Recent advances in brain imaging have found that the brain is an organ that continually builds and rebuilds itself by one's life experiences.

*Characteristics of the Brain.* The brain has a number of characteristics, only a few of which are...
many actions automatically and below the level of conscious control. Third, automatic functions that occur within the brain are located primarily in the occipital, parietal, and temporal lobes—the back,
top, and side of the brain, respectively. In contrast, conscious control actions take place in the cerebral cortex (e.g., the forebrain—the front of the brain; Restak, 2006). Fourth, the brain is plastic; the brain changes due to influences from the environment. Because of the influence of the environment on the brain, no two people are identical in the neural wiring of their brains. Fifth, not all brains are alike, even though they are basically similar. Tancredi (2005) has pointed out the neurobiology of the differences between female and male brains (e.g., females evidence greater empathy). Sixth, human brains differ from nonhuman brains. Seventh, research has found that the construction of meaning is very different from the processing of information. According to Modell (2003), the metaphor is the brain's primary way of understanding and remembering the world (Table 20.1).

Table 20.1 The Brain and Its Four Lobes

<table>
<thead>
<tr>
<th>Brain Lobe</th>
<th>Function</th>
<th>Results of Improper Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal lobe</td>
<td>The emotional control center of the brain responsible for forming one's personality and for making decisions. It is located at the front of the central sulcus where it receives information from other lobes of the brain. Most functions of the frontal lobe focus on regulating social behavior. The following are some important functions of the frontal lobe: Cognition, problem solving, and reasoning; impulse control; regulating emotions; regulating sexual urges; planning; motor skill development; parts of speech</td>
<td>It is more common to injure the frontal lobe than any of the other lobes of the brain because it is located at the front of the skull or brain. Damage to the frontal lobe often results in personality changes, difficulty controlling sexual urges, and other impulsive and risk-taking behaviors.</td>
</tr>
<tr>
<td>Parietal lobe</td>
<td>Parietal lobe has several functions including sensation, perception and spatial reasoning. This lobe processes sensory information from various parts of the body. Some specific functions of the parietal lobe include: Sensing pain, pressure, and touch; regulating and processing the body's five senses; movement and visual orientation; speech; cognition and information processing.</td>
<td>Damage to the parietal lobe may result in problems with spatial reasoning, reading, writing, understanding symbols and language. Right-side damage to the parietal area can impact a person's ability to dress himself or herself. Left-side damage to the parietal lobe can result in language disorders and disorders with perception.</td>
</tr>
</tbody>
</table>
Neurotransmitter

A neurotransmitter is a chemical that is released from a nerve cell that transmits an impulse from one nerve cell to another nerve, muscle, organ, or other tissue. It is essentially a messenger of neurologic information from one cell to another (Zillmer et al., 2008). Neurotransmitters contribute to a person’s cognitive, emotional, psychological, and behavioral responses or patterns in life (Table 20.2). A person’s production of neurotransmitters has been linked to environmental stressors and his or her lifestyle (including diet, coping strategies, and leisure time). Many of the problems that clients mention during therapy and counseling can be traced to their brain chemistry and to either overproduction or underproduction of specific neurotransmitters (Zillmer et al., 2008).

<table>
<thead>
<tr>
<th>Brain Lobe</th>
<th>Function</th>
<th>Results of Improper Functioning</th>
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</thead>
</table>
| **Temporal lobe:** There are two temporal lobes located on both sides of the brain that are located near the ears. | • The main function of the temporal lobes is to process auditory sounds. Other functions include:  
  • The temporal lobe contains the hippocampus, the part of the brain responsible for transferring short-term memories into long-term one. Therefore the temporal lobe helps to form long-term memories and process new information.  
  • It helps to form visual and verbal memories.  
  • It is involved in the interpretation of smells and sounds. | • The type of impairment that result from damage to the temporal lobe varies according to where the damage took place.  
• Temporal lobe damage can result in difficulty processing auditory sensations and visual perceptions, problems concentrating on visual auditory stimuli, long-term memory problems, changes in personality, and changes in sexual behavior. |
| **Occipital lobe:** This lobe is the smallest of the four lobes of the brain. It is located near the posterior region of the cerebral cortex near the back of the skull. | • The occipital lobe is the primary visual processing center of the brain. Other functions include:  
  o Visual-spatial processing  
  o Movement and color recognition | • Damage to the occipital lobe is less likely to occur than damage to the other lobes because the skull protects the occipital lobe.  
• Severe damage to the occipital lobe can result in loss of color recognition, visual hallucinations or illusions, and problems recognizing objects. |

comes from the Greek and means “point of contact.” Synapses, or specialized connections between neurons, allow signaling from one neuron to another to take place (Zillmer et al., 2008). Neurons communicate with each other within the brain and down the spinal cord. Neurons are interconnected into networks that have chemical and electrical communication systems. The brain functions as a complex system of neuronal circuits (Figure 20.2).

Three primary types of specialized neurons exist within the nervous system: (1) sensory neurons, which respond to touch, light, sound, and other stimuli; (2) motor neurons, which cause muscle contractions, influence glands within the body, and receive signals from the brain and the spinal cord; and (3) interneurons, which connect neurons in the same region of the brain or spinal cord (Zillmer et al., 2008).
problem behaviors that often bring people to therapy: (1) acetylcholine, a neurotransmitter that is critical for learning, optimal cognitive functioning, and emotional balance and control (deficiency causes deterioration of memory, increased forgetfulness, lack of emotional control, and increased aggression); (2) serotonin, a person's natural mood stabilizer and sleep promoter (deficiency of serotonin causes depression, difficulty sleeping, a sense of being disconnected, lack of joy); (3) dopamine, a person's natural energizer; and (4) gamma-amino butyric acid (GABA), which helps reduce anxiety and induces sleep (deficiency causes the feeling that it is hard to relax) (Farmer, 2009).

Therapy and counseling strategies that tend to release acetylcholine include exercising and using meditation on a consistent basis. Because serotonin deficiencies are associated with depression, therapists can help clients by assisting them to develop action-based strategies that produce new meaning in their lives. Dopamine production may be increased within a person via massages. Studies have reported that when patients with cancer and other medical disorders receive massage therapy, they experience increased levels of dopamine, serotonin, oxytocin, endorphins, and natural

<table>
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<tr>
<th>Neurotransmitter</th>
<th>Function</th>
<th>Imbalances</th>
</tr>
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<tbody>
<tr>
<td>Acetylcholine</td>
<td>Important for memory, learning, optimal cognitive functioning, emotional balance and control. Affects attention, alertness, and voluntary muscle movement.</td>
<td>A deficiency produces a deterioration of memory, increased confusion, forgetfulness, cognitive disorganization and eventually as one ages leads to Alzheimer's disease.</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Regulates movement, emotional wellness, and pleasurable feelings.</td>
<td>An oversupply of dopamine has been linked to schizophrenia and an undersupply has been associated with Parkinson's disease.</td>
</tr>
</tbody>
</table>
The mind emerges from patterns in the flow of energy and information within the brain and between brains. The mind is created within the interaction of internal neuro-physiological processes and interpersonal experiences (Siegel, 1999, p. 2).

### Neuroplasticity

The term *neuroplasticity* refers to the brain's ability to change and adapt as a result of life experiences (Butz, Worgotter, & van Ooyen, 2009; Goodfellow, 2003; Hernandez-Reif et al., 2004).

### Mind

The mind emerges from the brain, and it is shaped by interpersonal relationships. The mind can be defined as a process that regulates the flow of energy and information. Human relationships shape the neural connections from which a person mind emerges. According to Siegel (1999), "1. The human mind emerges from patterns in the flow of energy and information within the brain and between brains. 2. The mind is created within the interaction of internal neuro-physiological processes and interpersonal experiences" (p. 2).
Holtmaat & Svoboda, 2009). Research has demonstrated that the brain continues to create new neural pathways throughout one’s life and that it modifies existing neural pathways to adapt to new experiences, learn new information, and create new memories (Siegel, 1999, 2010).

Neuroplasticity is moderated by genetic factors and by dynamic epigenetic changes that influence the expression of genes without changing the DNA sequence. Psychologists and other helping professionals are interested in epigenetic processes because their external triggers (e.g., parental care, attachment, diet, drug abuse, and stress) can influence a person’s vulnerability to many diseases, including mental or psychiatric disorders (Volkow, 2010). In future decades, researchers will most likely gain additional insights about what forms the basis of neuroplasticity.

Two Cerebral Hemispheres: Right-Brain and Left-Brain Development

The human brain consists of two cerebral hemispheres—a right and a left brain. The brain works as a unified system, even though it has different structures and two hemispheres. Each brain hemisphere is associated with different functioning in the cortex. For instance, the left hemisphere controls the four Ls of functioning in the cortex: language (speech and reasoning), logic (stepwise reasoning and analysis), literality (facts and details), and linearity (“straight-line” thinking) (Siegel, 2012). The left hemisphere of the brain (the cerebral cortex and the structures of the midbrain) conducts what has been described as left-mode processing (Badnoch, 2008), meaning the management of information and information processing. The left side of the brain is good at tasks that involve logic, language, and analytical thinking. It is better at factual/semantic memory, critical thinking, numbers, and reasoning.

The right hemisphere, which is involved in right-mode processing, controls sensory input (auditory and visual awareness) processing, creative abilities, and spatial and temporal awareness. The right brain manages a person’s creative abilities and emotional responses. In the majority of mental processes, there is usually a bipartisan participation of the two hemispheres. Whereas the left hemisphere deals with externally focused attention and action, the right hemisphere concentrates on internally focused attention and action. Studies have reported that the right hemisphere is primarily responsible for reading social and emotional cues from other people. The right hemisphere of the brain seems to be more capable than the left hemisphere of regulating states of bodily arousal.

Both the right and the left hemispheres of the brain are involved in different ways of knowing the world. The right hemisphere seems to be able to perceive patterns within a holistic framework, observing spatial arrangements that the left hemisphere cannot sense. The right brain construes the overall meaning of events. Some abilities associated with the right hemisphere include the following: recognizing faces, expressing emotions, music, reading emotions, intuition, and creativity. It develops earlier, sees the world holistically, is largely

Inner Reflections

It has been said that the mind is formed by the relationships that we have. How would you describe your mind? What relationships were critical in forming your mind? What mindsets have you formed?

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Inner Reflections

Although research says that the two brain hemispheres work as an integral unit, some people believe that people are more right- or left-brain oriented.

Would you describe yourself as being more right- or left-brain oriented in your daily dealings with people?

Are the things you really like to do more associated with the right- or left-brain hemispheres?
Memory

Explicit Memory

All therapists deal with some form of client memory. Information that a person has to consciously remember is known as explicit memory. When an individual is trying to intentionally remember something (e.g., an algebraic formula), this information is stored in explicit memory. We use explicit memory on a daily basis, for example, to recall the time of a dinner date or a doctor's appointment. Explicit memory is also known as declarative memory. There are two types of explicit memory: (1) episodic memory, which contains a person's long-term memories of specific events and a person's internal sense of “I am remembering,” and (2) semantic memory, which consists of memories of facts, concepts, names, and other general knowledge information. Episodic memory is autobiographic. A woman may recall a sense of self as a high school student, as a new mother, and as a mother of teenage children.

Episodic memories are often communicated to therapists as stories about oneself. Siegel (1999) describes a 35-year-old woman who began to recount her experiences of having been raised by a violent, alcoholic father. He states,

When she began to tell her story, her eyes became filled with tears, her hands began to tremble, and she turned away from her therapist. She stopped speaking and seemed to become frozen, with a look of terror on her face. For the therapist, the feeling in the room was intense and consuming. The patient began to speak again, but this time she spoke of her father's “positive attributes.” (p. 43)

Implicit Memory

Implicit memory consists of things that a person does not purposely try to remember; it is both unconscious and unintentional. This type of memory is also called nondeclarative memory because a person is usually not able to consciously bring it into awareness. Implicit memories are often termed procedural memories, like hitting a baseball. A person does not have to recall consciously how to perform procedural memories. Although procedural memories are not recalled specifically, a person can still perform an activity after a break—such as riding a bicycle again, even though one has not ridden one in 20 years.

Memory Consolidation

During the process of psychotherapy, clinicians work with a client's memory. Clinicians want to know how clients remember the things that have happened to them because such memories indicate how they have constructed an interpretation of their lives. Memory consolidation is a neurological process that involves gradually converting information from short-term into long-term memory (Zillmer et al., 2008). A person's short-term memories are stored for only about 20 to 30 seconds. If information is to be retained so that it can be retrieved and used later, the contents of short-term memory must be moved into long-term memory (Kandel, 2005).

The memory consolidation process starts at the synaptic level as the brain begins to form new pathways to the information that comes to its attention. This process can take place over a period of days, weeks, months, or even years. Memories are spread out throughout the entire brain. The brain creates a neural map of the information so that memories can be retrieved at a later point. Memory consolidation is the process involved in coding a memory so that it can be retrieved at a later moment (Kandel, 2005). Without memory consolidation, there would be no way for a person to store information in the brain.

The hippocampus appears to assume an important role in memory formation and storage. Rapid eye movement sleep also seems to assist with the process of memory consolidation, and sleep overall is thought to help the brain refresh itself.
Although memory consolidation usually occurs over an extended period of time, studies of people involved in learning tasks have found that the brain can consolidate a memory successfully in less than an hour (Kandel, 2005). Rehearsal and memorization strategies are techniques that can promote faster memory consolidation. Repeating the same information over and over can cause synaptic changes in the brain that lead to rapid consolidation of memory. It is important that counselors understand the process of memory consolidation for clients. The process involved in memory consolidation is also important in a number of the newer brain therapies, including EMDR (Shapiro, 1995, 2001).

**Memory Reconsolidation**

Just as there is memory consolidation, there is also a process called memory reconsolidation. Imagine that all of the precious memories that you painstakingly made were suddenly erased? That thought is frightening to most people. Yet recent studies have revealed that every time you recall a specific memory, you make it necessary for that memory to be reestablished (Kandel, 2005). The term used to describe this memory process is reconsolidation—a term that recognizes the characteristic that long-term memories, when formed initially, are labile and subject to disruption over a period of hours. The good news for people who have experienced trauma in their lives is that previously long-established memories are also subject to disruption specifically during that period immediately after each time they are recollected. Reactivated memories must be put back into long-term storage by a process similar to that involved in the initial consolidation period—hence, the term reconsolidation.

Studies related to memory reconsolidation (Nader, Schafe, & LeDoux, 2000; Sara & Hars, 2006; Sara, 2000) have shown that a consolidated memory could again become susceptible to impairment for a discrete period of time after retrieval. The memory reconsolidation hypothesis overturned the belief that emotional learnings and acquired responses stored in long-term implicit memory are indelible—unerasable and permanent during a person’s lifetime. The existence of reconsolidation implies that the brain’s built-in neurodynamics allow a person to experience freedom from negative emotional learnings formed early in life. The reconsolidation hypothesis has important implications for psychotherapy. Memory research supports a nonpathologizing model of analyzing a person’s symptom production that is caused by a person’s unconscious emotional learning contained in one’s emotional memory. Ecker and Toomey (2008) have provided evidence of such a clinical process, named coherence therapy (Ecker et al., 2012). The basic tenets of coherence theory and eliminating symptoms of psychological issues using memory reconsolidation are discussed in the section on new brain-based therapies.

**Mirror Neurons**

Neuroscientific knowledge of mirror neurons is based on the work of the Italian researcher Gallese, who in 1995 studied macaque monkeys and found that a certain neuron fired when one monkey observed another monkey performing an action, which in this case was reaching for a peanut (Gallese, Fadiga, Fogassi, Rizzolatti, 1996). Mirror neurons may be summarized as follows:

**Inner Reflections**

Think about an event you have experienced in your life that you would like to erase or reconsolidate.

What is this memory?

Do you have any symptoms connected to this memory? If so, what are they?

Repeatedly pair the negative memory with a meaningful positive one, such that each time the negative memory comes forth, you activate a positive one alongside it. Has the negative memory become destabilized or changed in any way? How?
When a person observes another person engaging in a behavior, certain brain areas are activated, and these are the same brain areas that are activated whenever the first person performs the same behavior (Rizzolatti & Sinigaglia, 2008).

Mirror neurons connect visual and motor experiences and are involved in social functions such as learning, the development of gestures and verbal language, and empathic attunement. Commenting on the impact of observing another person’s hand gestures and speech, Newberg and Waldman (2012) have asserted,

A recent neuroimaging study showed that hand gestures and speech originate in the same language-related area of the brain. This overlap between words and gestures appears to be associated with a rare cluster of brain cells called “mirror neurons.” The neurons that fire in someone’s brain when they make a specific gesture also fire in your brain as you observe them. (p. 45)

Mirror neurons in the human brain help us understand the actions and intentions of other people (Gallese & Goldman, 1998). Both clients and therapists experience neural activation when clients talk about their problems during therapy. When clients describe in detail their challenges or problems, mirror neurons are activated in the therapist’s brain as he or she is engaged in deep listening and close observation of clients’ behaviors. Schulte-Ruther, Markowitsch, Shah, Fink, and Piecke (2007) have pointed out that the “same neuronal activity patterns occur in the same areas of an observer’s brain as in the brain of a closely observed and felt other person” (p. 1362). Neurological mirroring is facilitated when the interpersonal interactions between therapist and client are experienced as being nonjudgmental, positive regard, respectful, accepting, and empathic in nature (Schulte-Ruther et al., 2007).

The better therapists can mirror the neural activity in their clients’ brain, the more likely that they will be able to understand them (Newberg & Waldman, 2013). When therapists are able to accurately mirror their clients’ feelings, they create neural resonance between them. As Newberg and Waldman (2013) have stated,

If you really want to understand what the other person is saying, you have to listen and observe the other person as deeply and fully as possible. Otherwise your brains won’t mirror each other. If we can’t simulate in our own brains what another person is thinking and feeling, we won’t be able to cooperate with them. (p. 81)

Neuroscience and the Environment

Neuroscience provides an enlarged role for the influence of the environment on people. Brain development in humans is influenced by both heredity (genes) and environment. Environment is conceptualized in two fundamental ways: first, one’s early environment that shaped one’s initial brain development and patterns of thinking, feeling, and behavior and, second, the current environment in which the client finds himself or herself. A client’s current environment includes housing arrangements, relational affiliations, work situation, financial status, and any other significant environment variable.

Therapists can no longer ignore the impact of the environment on individuals’ behaviors, including their mental disorders. Most likely the emphasis on environment will strike a responsive chord for clinicians who perceive themselves to be multiculturalists and social justice counselors. Clinicians need to understand that the neuroplasticity of the brain suggests the possibility of change, even for mental illnesses that have strong hereditary links; for example, individuals suffering from schizophrenia can recover and lead productive lives. They, too, can hope for a positive future. While medication may be part of the treatment equation, it is only part of it.
Neuroscience may contribute to a greater emphasis on social justice as more and more studies are conducted on the effects of the environment on children’s and adults’ brains. Krugman (2008) has asserted that poverty poisons the brains of children. Neuroscientists are beginning to point out that children who grow up in poverty experience unhealthy levels of stress hormones, which hinders their neural development. Racism, sexism, and cultural oppression emit damaging cortisol in the brain. Ivey, Ivey, Zalaquett, and Quirk (2009) have maintained that clients need to be informed about how social systems affect their personal growth. These researchers have stated:

As counselors, we can help clients understand that the issue does not lie in them, but in oppressive systems. They should avoid self-blame and self-pity. We can build strengths through a wellness approach and a focus on positive gender and cultural identity. Neuroscientists have found that the brain fires most when seeing faces that resemble one’s own. This is an important component of antiracism training. . . . A social justice approach includes helping clients find outlets to prevent oppression and work with schools, community action groups and others for change. (para. 24)

Neuroscience research has shown how psychotherapy or “talking therapies” change the behavior of the brain, its chemical operations, and its structure (Linden, 2006; Rossouw, 2013). For instance, Arthur Brody and his colleagues (2001) have reported metabolic brain changes in clients with depression treated with interpersonal therapy. They found that subjects treated with interpersonal psychotherapy experienced a 38% decrease in their scores on the Hamilton Depression rating scale, while those treated with the drug paroxetine had a greater mean decrease in their scores. Both subgroups “showed decreases in normalized prefrontal cortex (paroxetine-treated bilaterally and interpersonal psychotherapy-treated on the right) and left anterior cingulate gyrus metabolism, and increases in normalized left temporal lobe metabolism” (p. 631). Similar findings supporting psychotherapy’s impact on a client’s brain were reported by Stephen Martin (2001) and his colleagues, who identified blood flow changes in depressed clients treated with interpersonal psychotherapy. The
Researchers are calling for a form of psychotherapy that is based primarily on neuroscience.

**Mental Health From a Neuroscientific Perspective**

Neuropsychotherapists present mental health in a manner different from the traditional Western way of thinking. One way to view mental illness is that one or more systems of the brain did not develop adequately and/or there is an absence of integration between various systems in the brain. To have a balanced mood, both right and left hemispheres have to be actively involved in an equal or democratic way and reciprocally balance each other (Cozolino, 2010). For instance, if a person has too much activation of the right side of the prefrontal cortex, he or she will experience depression and shame. If a person has too much activation of the left side of the prefrontal cortex, he or she will tend to have euphoria or mania.

The environment assumes a prominent role in activation of both right and left hemispheres of the brain—especially a person’s attachment pattern formed with a primary caretaker. Attachment with a primary caregiver establishes one’s emotional regulation and one’s feelings about oneself and others. If during the attachment process, a child gets the message that he or she is not valued, shame and negativity will predominate in the right hemisphere.

Moreover, a key component of mental health is the integration of cognition (left-hemisphere activity) and emotion (right-hemisphere activity). For instance, some individuals might react emotionally to most things, while others respond intellectually to emotional events. To achieve mental health, there must be a balance between one’s emotional and cognitive expressions and approaches to life.

Cozolino (2010) uses the concept of the social brain to challenge the Western value of individualism. Instead of saying that healthy “people are those who are autonomous and independent,” he contends that because one’s social brain is basically shaped in interaction with other people, healthy
people are those who rely on others throughout their lives for strength and development of their abilities. This interdependent view of healthy personality development resembles closely that of some Eastern cultures that emphasize the role of the group and the subordination of the individual to the group. Cozolino’s (2010) view of the healthy personality is consistent with several psychological theories, including relational theory (Mitchell, 1988, 1997) and attachment theory (Schore, 2000). Healthy relationships between people produce mentally healthy people. In contrast, disturbed relationships lead to mentally unhealthy individuals. Poor interpersonal relationships produce disorders of the social brain. Because the brain is an organ that adapts to its environment, one can change brain circuitry through relationships.

Cozolino (2010) asserts that optimal sculpting of the prefrontal cortex shapes our sense of ourselves, our trust in others, our intellectual and emotional intelligence, and our ability to regulate our emotions. He also maintains that the “Polyvagal Theory of Social Engagement” permits people to seek closeness to others without activating their fight-or-flight responses. When a person has good vagal regulation, one may become angry, upset, or anxious with a loved one without withdrawing or becoming physically aggressive toward them.

**Inner Reflection**

In your opinion, does labeling a mental illness as a brain disorder increase or decrease its stigmatizing effect?

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Maladaptive Mental Behavior and Mental Disorders as Brain Disorders

The *Decade of the Brain* redefined mental disorders as brain disorders. During this historical renaissance, neuroscientists focused on uncovering the brain processes involved in such disorders, and neuroimaging became the dominant tool in such investigations (Brockman, 2002). Neuroimaging technology has found that specific brain pathways, mostly located in the prefrontal cortex, are implicated in major mental disorders (Davidson & Begley, 2012). As a result of neuroimaging breakthroughs, researchers have begun to study mental disorders as brain circuit disorders, with an emphasis on normal and abnormal conduction between brain areas and circuits (LeDoux, 2003). Mental illness is characterized by thwarted neural growth.

What causes circuit disorder in the brain? Some scientists and practitioners trace the damaged circuit wiring in the brain to early attachment issues and parenting and to the individual’s contact with his or her surrounding environment (Arden, 2010; Cozolino, 2010; LeDoux, 2003; Siegel, 2010). Even though these early relationship issues are highly significant, most neuroscientists contend that the faulty circuit wiring in the brain can be changed with the appropriate psychotherapy interventions (Arden, 2010; Davidson & Begley, 2012). Neuroscientists assert that only human beings can help heal other humans. As Cozolino (2010) has stated, “Human brains have vulnerabilities and weaknesses that only other brains are capable of mending” (p. 307). An individual’s mental health is then connected to the quality of human relationships that he or she experiences. The emerging paradigm of neuropsychotherapy explains scientifically individuals’ behavior, which was previously only “guessed about” in other schools of psychotherapy.

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**THE THERAPEUTIC PROCESS ——**

The Therapeutic Relationship From a Neuroscientific Perspective

Neuroscience offers a new conceptual framework for clinicians’ understanding of what takes place during the therapy hour. Therapy involves a clinician’s assisting clients to restructure old neural pathways and to build new ones to help them deal with their challenges and to lead a more satisfying life. When one uses the neuroscience conceptual framework, talk within the therapy hour becomes much more purposeful and intentional rather than hit or miss. The therapist is intentionally helping...
clients to engage in the process of neuroplasticity. Therapy may be considered successful to the extent that therapists are able to help create a therapeutic experience that results in creating neuroplasticity for clients (Cozolino, 2010).

Neuroscience can be used to help a therapist conceptualize what is happening in a client’s brain. From the neuroscience worldview, psychotherapy is an interaction between two human brains and the neural pathways that therapist and client have created for themselves as a result of the interaction between their genetics and their life experiences. Additional support for this conceptualization is provided by Beitman and Viamontes (2006), who described the therapeutic relationship as “a relationship between two brains and their bodies” (p. 214). Both neuroscientists and clinicians have maintained that therapists can help a client develop new neural pathways as a result of establishing a caring and safe therapeutic relationship that communicates that they understand and accept him or her unconditionally (Hanson, 2013; Kandel, 1998, 2007; Siegel, 2010).

The therapeutic relationship can “enhance or replace an attachment relationship, based on how the right brain develops (the hemisphere that controls emotions) and continues to function in adulthood” (Farmer, 2009, p. 122). Therapeutic attachment facilitates neural restructuring in the right brain of clients (Farmer, 2009). In working with clients, therapists deal with more than just negative emotions, self-imposed limits, and bad memories. When therapists are engaged during the therapy hour, they deal with the very strategies that their clients use to encounter and cope with life. Clients generate neurological pathways of behavior in their brains. They even become addicted to their own brain chemicals as they repeat again and again life strategies that may not have been working for a long period of time. In essence, clients become addicted to their behavioral strategies that they use for living. Neural restructuring can change a person’s habitual neurological pattern of behavior.

The first step in helping clients change their neural networks is to identify them. To achieve this goal, clinicians must engage in deep listening to what their clients are saying about their life situations, and especially what they are saying about themselves, such as their difficulty trusting others, problems in establishing and maintaining relationships, low self-esteem, or poor anger management. Helping professionals must understand that the already established neural networks in their clients’ brains are based on their own life experiences. If clients do not have an established network for something, then they do not have a reference point for change. As clinicians identify clients’ neural networks, they can then begin to consider experiences that might help them build new neural networks that are more satisfying and less problematic. Clinicians might consider experimenting with brain sensory inputs such as art therapy, music therapy, therapeutic stories, and psychodrama. Sensory inputs tend to engage clients’ neural networks to become active and open to learning new information. It is important that clients feel that they are in control of changing the neural networks in their brains.

How might a therapist help clients see a connection between their own brains and what they are working on in therapy? Both Cozolino (2010) and Hanson (2010) have pointed out that when a therapist translates psychological issues into neural terms, such issues become demystified, normalized, and de-stigmatized. The client is taught to recognize how the neural networks associated with the amygdala, for instance, bring about states of fear and anger. It is not that the client is crazy or weird but rather that the client might have to deliberately and intentionally change the wiring of his or her neural networks by having new affirming life experiences not built on fear (Arden, 2010).

**Inner Reflection**

Should the therapist be interested in fostering therapeutic attachment with clients? Why or why not?

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**Goals of Neuropsychotherapy**

The neuroscience perspective maintains that therapy is a matter of helping clients to build new
positive neural pathways that emphasize clients' strengths and to repair or extinguish neural pathways that impair clients' functioning in their inner and outer worlds (LeDoux, 2002). An important goal is to activate positive emotions and deactivate negative ones.

Another goal of neuropsychotherapy is to help clients integrate their brains, especially the two cerebral hemispheres, the neural circuits, and their functioning. According to Siegel (1999), neural integration is basic to self-organization and to the ability of the brain to create a sense of self. Tucker, Luu, and Pribram (1995) have suggested that integration within the brain may deal with specific anatomic circuits: (1) vertical, (2) dorsal–ventral, and (3) lateral.

A client's autobiographical narrative can reveal integration or incoherence. A client evidences a coherent autobiographical narrative when his or her narrative reflects a blending of left- and right-hemisphere processes. When a client has limited access to the right hemisphere's representational processes, his or her autobiographical narrative may be incoherent. In contrast, when an individual is able to draw on the right hemisphere, the left brain is able to make sense by integrating a coherent life story. Integration of left- and right-hemisphere processes produces coherent client narratives (Siegel, 1999).

**Role of the Neuropsychotherapist**

**Who Is a Neuropsychotherapist?**

A neuropsychotherapist may be defined as a psychotherapist (who may be eclectic or prepared educationally in a specific theoretical school of psychotherapy) who uses neuroscience to enhance his or her psychotherapeutic interventions. A neuropsychotherapist has a solid knowledge of the neurobiological foundation of individuals' mental states and behavior. The ideal neuropsychotherapist has substantial insight into the activity of a specific neural network involved with, for example, a client's fear, as well as a cultural and environmental understanding of the impact of clients' interpersonal relationships on their emotions and behavior (Grawe, 2007). A neuropsychotherapist uses a multidisciplinary approach to working with clients. A neuropsychotherapist is one who understands the different levels of a person's being and conducts therapy within a neurobiopsychosocial framework.

Kandel (2006) has suggested that client care is the therapist's most important responsibility. Therapists must develop an understanding of the neuropsychological principles that govern not only their own behavior but also that of their clients. Therapists whose practice is informed by neuroscience learn how to cultivate their client's neuroplasticity. They must also be conscious of creating mirror neurons when working with clients. Therapy should produce new pathways of neural firing through the creation of a safe therapeutic environment and a corrective emotional experience (Allison & Rossouw, 2013). One role for a therapist is to help a client down-regulate his or her stress response so that new patterns of neural activation can take place. The therapist provides an environment in which a client's basic needs for safety and control are met so that a shift can take place from client patterns of avoidance and protection to patterns of approach. As Allison and Rossouw (2013) have stated,

New neural patterns can be activated by down regulating the stress response and enhancing the basic needs of attachment and control. Safety is thereby facilitated through the development of new neural pathways that shift unhelpful patterns of thinking, feeling, and behaving. (p. 22)

Cozolino (2010) has maintained that a therapist can use neuroscientific principles to improve therapy by (a) using multiple means to influence the brain, (b) choosing and combining different treatments for clients, (c) educating clients about brain functions, (d) encouraging the rewriting of...
self-narrative by honoring the malleability of memory, and (e) emphasizing optimism and growth as possible outcomes of satisfying relationships.

**What Happens If a Therapist Focuses on a Client’s Negative Life Events?**

For decades, therapists have focused on their clients’ problems and negative life events. The belief was that it was therapeutic for therapists to spend hours talking about a client’s negative reactions to his or her father or about a client’s feelings of being left out and ridiculed as a child and as an adolescent. Yet recent research in neuroscience has indicated that such a focus may harm rather than help clients (Seligman, Steen, Park, & Peterson, 2005). The very moment a person or a therapist expresses even the slightest degree of negativity, a sense of negativity is increased in both the speaker’s and the listener’s brains (Fredrickson, 2009).

Negative words or even repeatedly uncovering or analyzing the negative events in a client’s life may only serve to remind clients of their failures and inadequacies. Clients become mired down in the therapeutic quicksand of “My mother never loved me,” “No one on both sides of my family liked me,” or “I was always considered a problem child.” When therapists have clients continually rehearse the negative circumstances of their lives, they send alarm messages to the client’s brain—the amygdala. The quicker therapists are able to stop talking about the client’s negative life events, the more readily they are able to generate a sense of safety and well-being within the therapy hour. Newberg and Waldman (2013) have explained that if you focus on a word such as peace or love, the emotional centers in the brain become calm. Even though the outside world has not changed, you feel safe and secure just by focusing on these words. This illustration demonstrates the neurological power of positive thinking, which has been supported by hundreds of well-designed studies.

When therapists work with clients to reframe negative thoughts and worries into positive affirmations, the therapeutic process improves, and the client regains self-control and confidence (Fossati et al., 2003). Therapists’ interpretations that emphasize the negative circumstances of a client’s life stimulate anxiety, while positive statements stimulate relaxation. Put in an alternate way, if a therapist focuses on a client’s strengths (strengths-based therapy), the client will begin to experience a sense of peacefulness in herself or himself as well as toward others. The client’s thalamus responds to the therapist’s incoming message of strength instead of weakness, and it then relays this message to the rest of the brain. As a consequence of the strength message, the client is likely to experience the release of pleasurable brain chemicals such as dopamine, the reward system of the brain will be stimulated, and client anxiety and self-doubts are likely to dissipate (Brassen, Gamer, & Buchel, 2011; Fredrickson, 2009).

Concentrating on a client’s strengths to deal with life challenges causes a client’s body to relax. Strengths-based therapy stimulates a client’s neocortex. Repeated highlighting of client’s strengths may even increase the thickness of the neocortex and shrink the size of the client’s amygdala, the fight-or-flight response mechanism in the brain (Newberg & Waldman, 2013).

**Role of the Client**

The role of the client in neuropsychotherapy is similar to that for the other theoretical perspectives discussed in this book. A major difference may lie in the tools that a neuropsychotherapist might use, such as neuroimaging. Clients may also be asked to be open to using the expressive arts and other sensory techniques to engage the right hemisphere of their brains. In addition, therapists who actively use neuroscience techniques also recommend that clients engage in the practice of mindfulness (Hanson, 2013).

**Therapy as Right-Brain to Right-Brain Interaction**

Neuroscience has helped reconceptualize therapy as partly a process that involves both
left-brain to right-brain and right-brain to right-brain interaction between the therapist and the client. Therapists have changed not only what they think about therapy but also what they believe happens during therapy and how they can influence the therapeutic process. For instance, from the early days of Freud, psychotherapy has been primarily about using words—a left-brain process—designed to effect changes in a client's emotions and way of viewing the world and what has happened to him or her. For several decades, especially after the cognitive force in psychotherapy, the major focus in therapy was designed to help clients think about their irrational ideas, their negative emotions.

Therapists now understand the biology of emotions and feelings (Schore, 2003). From brain-based studies, they have uncovered what feelings are located in what parts of the brain, as well as what neural substrates continue to support such feelings. The left hemisphere primarily engages in logical thinking, whereas the right hemisphere deals with one's emotions.

Neuroscience provides a framework for right-brain to right-brain therapy. It points out that whatever we turn our attention to will cause a neuron to fire. When the therapeutic relationship becomes a point of a client's and a therapist's focal attention, brain change within the client becomes possible. When the therapist and client are engaged in moment-to-moment relational-emotional experience, this process will help the client's brain to build new implicit and explicit memory patterns regarding the experience (Siegel, 2010). For instance, the client develops a visual image of his therapist smiling at him with respect, appreciation, and compassion. This relational experience becomes real, is encoded into implicit memory, and, if repeated a sufficient number of times, replaces the old, disordered patterns of relationships.

Right-brain to right-brain therapy refers to therapy that is attachment based. The therapist uses emotion-focused techniques to activate and rewire the early unconscious patterns processed and stored in the right hemisphere of the brain when such patterns are unhealthy. In reality, a therapist has to use left-brain to right-brain as well as right-brain to right-brain therapy because he or she has to be able to conceptualize and label what is taking place within the client and during therapy. Schore (2003) has emphasized right-brain to right-brain therapy because it serves as a counterbalance to the dominance of the left brain in therapists' usual dealings with clients. The focus is on the client's feelings and emotions and on the therapist's becoming an adoptive attachment figure for the client. The therapist relates to the client so as to foster the development of a secure attachment. The belief is that what heals a client who has negative attachment experiences is the relationship with the therapist.

Schore (2003) has used right-brain to right-brain therapy to describe a therapist's dealing with deep emotional issues—especially early-attachment issues. According to him, the right hemisphere of the brain stores the 3 Rs, rationality, regulation of affect, and resilience—factors that become the foundation of a person's sometimes lifelong exploration, learning, and growth. Neural patterns of these 3 Rs are created by the time a child is 18 months old, and they remain fairly unchanged well into a person's early adulthood (Schore, 2003). Using research from neuroscience, Schore (2003) has asserted that the experiences that we have with early significant caregivers are important because they establish subsequent behavioral patterns. From these early experiences, we learn that our needs and feelings are either important or not—that we should approach or avoid people and the challenges of life.

When early attachment experiences are repeated over and over again, they cause neurons to fire and neural pathways to develop—thereby making it more likely that with similar or even new experiences these same neurons will fire once again in the same patterns that strengthen the old neural circuits and networks of the three Rs—relationality (relationship issues), regulation of affect, and resilience. That is, the brain stabilizes our experiences into patterns of neural firing that determine how we respond to future new experiences.

Essentially, right-brain to right-brain therapy creates new experiences and installs them
reduce/eliminate old neural pathways: These are essentially techniques that are designed to make changes in the brain—thought stopping, positive reinforcement for new behavior, and so on—and are already broadly in use.

2. Techniques related to the therapeutic relationship: This involves the model of compassionate communication (Newberg & Waldman, 2013).

3. Techniques that involve the integration of the right and left hemispheres of the brain, the wheel of emotional awareness: This helps clients to build their attention strength and stimulates neuronal activation and growth to promote linkages (what Siegel, 2010, called Mindsight techniques).

4. Techniques related to the client’s emotional state—increasing balance, harmony, and hope. Hope is always critical. Strengths-based techniques are also important to lower a client’s defenses and to increase his or her motivation to produce the desired change.

Mindsight Techniques

To develop neural resonance with clients, Siegel (2010) suggests that therapists use an exercise called the “wheel of awareness” (p. 94), which is a metaphor for how a person can become aware of any element in his or her inner or outer worlds. The goal is to increase the therapist’s awareness of where he or she is with the client at any given moment during therapy. “The therapist can then focus attention (the spokes) on any element of the rim. After the therapist reaches a point of inner peace (using mindfulness techniques associated with the wheel of awareness), he or she can then work with the client on ‘SNAGging’ the brain—stimulating neuronal activation and growth—to promote differentiation and then linkage” (p. 98).

HEAL Strategy

“Taking in the good” is a strategy that helps clients focus on the positivity in their lives. To assist clients with taking in the good in their lives, Hanson (2013) has developed the acronym HEAL.
Eye Movement Desensitization and Reprocessing

EMDR is a neurologically based therapy approach that Francine Shapiro (1995, 2001) developed to resolve traumatic events, such as rape, and negative experiences in combat, as well as other disturbing, unresolved life issues. It is an integrative approach that includes elements of psychodynamic, cognitive-behavioral, interpersonal, experiential, and body-centered therapies. EMDR psychotherapy is an information-processing therapy that uses eight phases to address various mental health problems (see www.emdr.com/general-information/what-is-emdr.html).

The eight phases of treatment using EMDR are as follows:

**Phase 1 — History-taking sessions:** The therapist assesses the client’s readiness for EMDR and develops a treatment plan. The treatment plan deals with recent distressing events, current situations that elicit emotional disturbance, related historical incidents, and the development of specific skills and behaviors that will be needed by the client in future situations.

**Phase 2:** The therapist makes sure the client has sufficient methods for handling emotional distress and that the client is in a relatively stable emotional state.

**Phases 3 to 6:** A target is identified and processed using EMDR techniques that involve the client identifying the most vivid visual image related to the memory, a negative belief about the self, related emotions, and body sensations. The client identifies a positive belief, which is rated, and so is the intensity of the negative emotions.

Following this, the client is asked to focus on the image, negative thought, and body sensations while at the same time moving his or her eyes back and forth, following the therapist’s fingers as they move across his or her field of vision for 2 to 30 seconds or more, based on the client’s needs. In addition to using eye movements, the therapist can also use auditory tones, tapping, or other types of tactile stimulation. The therapist tells the client to notice

where $H =$ positive experience, $E =$ enrich it, $A =$ absorb, and $L =$ link it with positive and negative experiences. Step 1 activates a positive mental state in the client, while Steps 2 to 4 help install taking in the good in a client’s brain. The therapist asks the client to notice a positive experience in his or her life. For instance, the therapist might ask the client to think about something for which he or she is grateful or to think about a job that was performed well. In Step 2, the therapist requests that the client stay with that experience for 5 to 10 seconds so that positive feeling is felt throughout the client’s body. As the client thinks about the experience and enriches it, neurons begin firing together so that they will wire together. Step 3 involves absorbing that experience. In Step 4, the client is asked to link the positive and negative material. Hanson (2010) states,

For example, when you feel included and liked these days, you could sense this experience making contact with feelings of loneliness from your past. If the negative material hijacks your attention, drop it and focus only on the positive. . . . Whenever you want, let go of all negative material and rest only in the positive. (p. 63)

The pairing of the positive and the negative helps uproot the neural pathways that have been wired together because of repeated negative life experiences.

RECENT BRAIN-BASED THERAPIES: EMDR, COHERENCE THERAPY, AND BRAINSPOTTING

Although there is no universally recognized theory of neuropsychotherapy, several new brain-based therapies have emerged that could be included under the neuropsychotherapy paradigm, including EMDR, coherence therapy by Bruce Ecker and colleagues (2012), and brainspotting therapy by David Grand (2013).
symptom. Usually, 12 sessions are necessary for the client to obtain complete relief from the symptom (Ecker & Hulley, 2006).

Ecker et al. (2012) maintain that memory reconsolidation is the brain’s only known process capable of erasing an emotional learning. This theoretical approach guides clients to retrieve implicit, emotional learnings into awareness. One benefit of coherence therapy is that it does not pathologize a person’s presenting symptoms. They are just implicit memories that need to be reacti-
vated and, immediately after the reactivation, taken through a process of memory reconsolidation. Ecker and colleagues contend that our knowledge of memory reconsolidation will create transfor-
mational change for therapy and could serve as a unifying framework for psychotherapy integration. The authors call for brain imaging studies to pro-
vide empirical evidence for coherence therapy and memory reconsolidation.

Brainspotting

According to David Grand (2013), brainspot-
ting therapy evolved from his work using EMDR in his private practice. It is a focused treatment that works by identifying, then processing, and releasing core neurophysiological sources of emotional/body pain. It is believed that brainspotting taps into and har-
nesses the body’s innate self-scanning capacity to process and release focused areas (systems) which are in a maladaptive homeostasis (frozen primitive survival modes). (See https://www/brainspotting .pro/page/what-brainspotting)

A brainspot is the eye position connected to the emotional activation of a traumatic/emotion-
ally charged issue within the brain, most likely in the amygdala, the hippocampus, or the orbito-
frontal cortex of the limbic system. A brainspot is “actually a physiological subsystem holding emotional experience in memory form. When a brainspot is stimulated, the deep brain reflexively signals the therapist that an area of significance has

Coherence Therapy

Coherence therapy is an experiential system of psychotherapy that gives memory reconsolidation a central role. In fact, the steps of coherence therapy follow closely those outlined for the memory recon-
solidation process by brain researchers. The therapeu-
tic process for coherence therapy is experiential rather than analytic (Ecker et al., 2012). The goal of this form of brain-based therapy is to have the client experience during therapy personal constructs that underlie the unwanted symptom and to undergo a natural process of revising or dissolving those constructs, thereby terminating the existence of the
been located” (see https://www/brainspotting.pro/page/what-brainspotting). Although brainspotting typically takes place outside of a client’s awareness, there are a number of reflexive responses that indicate a brainspot has been located. These reflexive responses include eye twitches, blinks, pupil dilation, facial tics, yawns, foot moving, and body shifting. The brainspot can be accessed and stimulated by holding the client’s eye position while the client is focused on the problem being addressed in therapy. Therapy is directed to activating, locating, and processing the brainspot. Oftentimes, clinicians use biolateral sound CDs because biolateral sound enhances the brain’s processing abilities.

There are more than 5,000 people who have been trained in brainspotting. According to the Brainspotting website,

Brainspotting is a “body to body” approach. The distress is activated and located in the body, which then leads to the locating of the brainspot based on eye position. As opposed to EMDR where the traumatic memory is the target, in Brainspotting, the brainspot is the target or “focus or activation point. Everything is aimed at activating, locating, or processing the brainspot” (see https://www/brainspotting.pro/page/what-brainspotting).

NEUROSCIENCE AND THE DSM-5

Neuroscience and Challenges to Diagnosing Mental Disorders—the DSM

The pervasiveness of neuroscience can be seen in the implicit challenges it is posing for the entire diagnosis of mental disorders. For instance, in May 2013, the American Psychiatric Association (2013) published its newest revision of the Diagnostic and Statistical Manual of Mental Disorders (fifth edition, DSM-5), the major manual for diagnosis in the world, which replaced the DSM-IV-TR (fourth edition, text revision, 2000). The DSM-5 is based on the same principles that the American Psychiatric Association has followed for a number of editions of this manual. The DSM system has limited validity because it is supported by few studies verifying its diagnostic categories. The DSM system uses consensus by groups of clinicians to establish validity rather than clinical research data. It lacks neurobiological data to support its diagnostic categories.

Just prior to the release of the DSM-5, the National Institute of Mental Health (NIMH—the world’s largest funding agency for research into mental health) withdrew its support from the manual. Thomas Insel, the director of NIMH, stated that the institute will no longer fund any research projects that rely on DSM criteria and that the institute will be “re-orienting its research away from DSM categories” (see NIMH, http://www.nimh.nih.gov). The official statement from NIMH (2013) was that the DSM-5 only offers “fumbles and errors” and that “symptom-based diagnosis once common in other areas of medicine has been largely replaced in the past half century as we have understood that symptoms alone rarely indicate the best choice of treatment.”

The NIMH (2013) suggested an approach based on developments in neuroscience and on brain-based research that was founded on the following assumptions:

- A diagnostic approach should be based on the biology, and symptoms must not be limited by the current DSM categories.
- Mental disorders are biological disorders involving brain circuits that implicate specific domains of cognition, emotion, and behavior.
- Each level of analysis should be understood across a dimension of function.
- Mapping the cognitive, brain circuit and genetic features of mental disorders will produce new and better targets for treatment.
subjects showed lower neural activation in this part of the brain. Citing a number of studies, Blanding (2010) concluded that cultural interactions produce certain patterns of neurological responsivity that are reflected in brain imaging procedures.

Moreover, neuroscience has provided some insight into how one’s race influences perceived racial group trustworthiness (Stanley et al., 2012). Within the brain, the striatum and amygdala are the regions of the brain involved in trust decisions and trustworthiness estimation. The investigators used BOLD, blood oxygenation level–dependent activity, while individuals completed a series of single-shot trust game interactions with real partners of varying races. They found that White/White and Black/Black groups produced greater levels of trust while Black/White groups produced far less trust. Black-versus-White partner combinations produced greater activity in the amygdala, the emotional alarm center of our brains.

Clearly it would seem reasonable to expect that culture does have an impact on the brain. The verdict is out regarding whether or not individuals from Western cultures have a brain organization pattern that favors the left as opposed to the right hemisphere, whereas just the reverse is held true for individuals from Eastern cultures. Some Eastern cultures emphasize meditation and yoga, practices that function to calm the brain and, specifically, the amygdala. Could the greater emphasis on individualism, for instance, explain Western societies’ high rate of violent crimes?

**In your opinion, should the DSM-5 be discarded or simply revised?**

**How useful is the DSM-5 for working with clients?**

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**CASE ANALYSIS**

**Justin and Neuropsychotherapy**

Justin greeted his counselor with his familiar “Hi Doc, what are we going to do today?” “Didn’t you tell me that we were going to be working on my brain? It’s all messed up, Doc,” Justin laughed. “We can go on to something else.” “I don’t think that your brain is messed up, Justin. You’ve got a good brain. You’re smart; you can draw; you can do a lot of different things with your brain, Justin. What I want us to work on today is increasing your knowledge of what is happening in your brain when it is functioning well and what’s happening when it’s not working so well.”

(Continued)
So I brought in two things that I want to share with you. The first thing I want to do is to show you a brief video by Dr. Daniel Siegel on the teenage brain, even though you’re not quite 13 yet. The video is about 7 minutes long, and in it, Dr. Siegel uses his hand in a useful way to think about the brain. He also talks about what goes on in the brain of teenagers, why they make what seems like some crazy choices—doing things that if they had a moment to think about the situation, they might not do. Then the second thing I’d like for us to do is to look at the model of the brain that I have on my desk and maybe engage in an exercise or two, depending on the time that we have left. How does that sound to you? Do you think you would like to do these things today?”

“Sure, I’m game. You know, Doc, I don’t mind looking at a video and talking about it.”

“Ok. But before we look at the video, I would like to get your thoughts about why there is sometimes friction and conflict between teenagers and their parents and teenagers and other aspects of our society—like school,” the counselor said.

“Oh, that’s easy,” Justin replied. “It’s like... it’s like they’re always telling us what to do—like do your homework, wash the dishes, stop watching so much TV, get up early enough so that you’re not late for school, and so on and so on. It never stops. It’s like we don’t have a mind of our own. They don’t trust us to do the right thing.”

“So you feel as if you are not given an opportunity to make up your own mind about things, that adults don’t trust you to make the right decisions,” the counselor interjected.

“Exactly,” Justin said, shaking his head. “I know that my mom doesn’t trust me. I can look at her eyes and see that she is probably thinking, ‘You’re not going where you said you were going. You tell me anything just to get out of the house.’ And sometimes she’s right. I want to be with my friends. I don’t want to be treated like some kind of a ‘Momma’s boy.’”

“Well, Justin, the video raises some of the same issues that you just mentioned. Let’s watch it for 7 minutes and get your reaction to it,” the counselor said.

The video showed Dr. Siegel putting his hand in the way to simulate the brain. He described how certain parts of the brain dealt with strong emotions, such as anger and fear. The amygdala was implicated for fear and angry responses to events. The video raised the question about why young people sometimes make such poor decisions. The video pointed out that during adolescence, the brain is experiencing a massive and necessary integration of functions that will have a long-term effect; that a young man’s solidarity with his peers was evolutionary insofar as young people banded together because they understood that down the line, they would be living in a world with their friends and peers. The shared experiences that adolescents have with each other enables their generation to become leaders. Adolescents are at the peak of their creative powers and courageousness. Furthermore, Siegel mentioned the four qualities of the adolescent mind: novelty seeking, social engagement, increased emotional intensity, and creative exploration.

After viewing the video, Justin said, “Wow, I didn’t know that’s why I do some of the crazy things that I do.”

The counselor responded, “What do you mean, Justin? Can you elaborate a little more about ‘why you do the crazy things that you do?’”

“Well, things like what got me in trouble with the law and got me sent to you. My friends came by my house, and they wanted to go to the mall. I wanted to be with them. I didn’t want to stay at home with my mom. We were going to go out and have some fun. I had no idea that that fun would land me in jail; otherwise, I would have stayed at home.”

“We were in Walmart, and one of my friends said, ‘Let’s see if we can steal something and get away with it.’ None of us had any money. At first, I thought that it was crazy. I could see the cop standing near the exit of the store, and I thought, ‘Are you crazy? We could get caught.’”

(Continued)
“Then my friend said, ‘Chick, chick, chick; you’re just chicken, Justin.’ So he stole something. I’m not even sure what he stole; and a store detective told him to put it back. He didn’t, and we all ran out of the store. The cop ran after us, and we were caught and put in jail.”

“How are you connecting what happened to you at the mall and the video, Justin?”

“Well just like the video said, young people like to be with their friends, and sometimes they will do things in groups that they wouldn’t do if they were by themselves. I wanted my friends to like me. It was exciting that they invited me to go to the mall with them. I felt that I was finally doing something different from what I usually do at home.” Justin sighed, remembering the sequence of events that had landed him in trouble. “Maybe if I hadn’t run,” Justin said. “Maybe I should have told my friend that I was leaving because I didn’t want any part of the stealing. It all happened so fast.”

“What you’re saying to me is that if you had been alone, what happened would never have happened. You wanted your friends to like you, and you made the poor choice of sticking with them when you knew that one of them was going to steal something on a dare.”

“You’ve got it, Doc. I should have never gone out with them that night. I knew that Darren had been caught stealing at the mall a year ago. Still, I went with them.”

“Choices,” the counselor responded. “We all make some bad choices in our lives that we wish we had never made. You can’t undo any of the choices you’ve already made. You have to move forward, Justin.”

“We’re running out of time, and I want to make sure that you get an opportunity to look at the brain model on my desk. Remember, Dr. Siegel spoke about where fear is located in the brain? Well here’s where the amygdala is located, and when it is stimulated in fear or anger, our emotions can get out of control. This is the part of the brain that Dr. Siegel called our older brain, the reptilian brain. Here, put your hand on the reptilian brain. Sometimes when our emotions are out of control, it’s because the reptilian brain has hijacked the front part of our brain—the prefrontal cortex. The next time you find yourself becoming so angry that you just want to hit someone, say to yourself, ‘I’m not going to let my old brain hijack my thinking.’”

Justin said back in his chair and put his hands behind his head, as if he had just received a new insight. “Before, I thought that I couldn’t do anything about my anger. Next time I get real angry, I am going to put my hand on the back of my brain and say, ‘You’re not going to hijack me, not today.”

SUMMARY

A dominant theme throughout this chapter is that the human brain is a social brain that depends on the quality of its relationships with people and the surrounding environment. The neuroscience approach to psychotherapy has a strong environmental emphasis, and it is one that encourages a wellness orientation for helping professionals and their clients.

Neuroscience has provided scientific explanations of therapist and client interventions that were previously not well understood. Neuroscience is clearly the fifth force in psychotherapy because of its scientific findings regarding the brain, its functioning, and what happens during the therapy hour when therapists and clients work together to change old, default, and oftentimes destructive patterns of behavior.

The chapter began with a brief overview of key contributors who linked neuroscience and psychotherapy. Therapists tend to use two patterns for incorporating neuroscientific knowledge into their practice: (1) they may retain their usual theoretical framework (psychoanalysis, cognitive-behavioral, social constructivist, etc.) or (2) they may turn to developing a new approach that can best be labeled neuropsychotherapy. This chapter first identified key concepts and terms used in neuropsychotherapy. The rest of the chapter was dedicated to
providing a framework for neuropsychotherapy that examined factors such as the therapeutic alliance, the role of the therapist, right-brain to right-brain therapy, and the techniques and methods that prominent neuroscientists have proposed in their therapeutic practice. The topic of cultural neuroscience was discussed to help practitioners think about the relevance of brain science for working with culturally diverse clients.

Mental health specialists are experiencing an exciting period after the Decade of the Brain. Research has indicated that the so-called talking therapies are more important than was thought previously. When therapy is provided in an enriched environment, new patterns of neural activation can be promoted within clients’ brain functioning. Studies have found that the therapeutic alliance, limbic mirror neuron effect, and therapist facilitation of safety and client control are critical to promote positive neural change in clients. The process of positive brain change in clients via therapy or counseling is facilitated by the therapist’s activation of the mirror neuron system, enhancing cortical blood flow to enable good solutions to problems and strengthening new activation of neural patterns to enhance long-term patterns and reduce risk of relapse into default neural protective patterns that may be destructive in clients’ lives.

Neuroscience research on mirror neurons provides one of the most profound indicators of the interconnectedness of human beings. We are all connected together in some way through the mirror neuron process. The talking therapies provide a safe environment that encourages the building of healthy new neural pathways in clients. However, these new neural networks are usually fragile. To prevent a client from returning to destructive or negative default neural patterns, therapists must promote sufficient neural activation toward new patterns of firing so that the default patterns are changed. The therapist’s interventions are guided by Hebb’s finding that neurons that fire together sufficiently wire together.

Studies have found that a variety of talking therapies can be effective in promoting neural change within clients. Grawe’s (2007) meta-analysis demonstrates that the single common denominator to promote change via talking therapies is the therapist’s use of the basic principles of neuroanatomy. These key principles are the therapist’s (a) activation of the client’s limbic mirror neuron system, (b) promotion of safety (down regulation of client distress), (c) enhancement of cortical blood flow, (d) strengthening positive neural activation networks, and (e) encouraging healthy social relationships and interactions with one’s environment.

**SUPPLEMENTAL AIDS**

**Discussion Questions**

1. In your opinion, what impact, if any, might present and future findings in neuroscience have on the social justice movement in counseling and psychotherapy? Do you believe that neuroscience findings might highlight the adverse effects of being routinely exposed to increased levels of family violence, poor attachment, and lack of social support?

2. Neuroscience findings are being considered in dealing with attention deficit disorders in children and adolescents. Discuss the pros and cons of such research.

3. Let’s suppose that you have just completed your master’s degree in counseling or social work. What neuroscientific principles or intervention techniques would you consider using in your new private practice?

4. To what extent do you think the value of neuroscience for psychotherapy is overstated or understated?

5. If you had to choose only one of the neuroscientific approaches to psychotherapy, which one would that be and why?

**Glossary of Key Terms**

(Please note that the terms listed below are paraphrased from *Brain Facts: A Primer on the Brain and Nervous System*, on the website for the Society of Neuroscience: http://www.sfn.org.)
acetylcholine  A neurotransmitter that is active in the brain, where it regulates memory, and in the peripheral nervous system, where it influences the actions of skeletal and smooth muscle.

amygdala  A structure in the forebrain that is part of the limbic system and that plays a critical role in emotional learning, especially within the context of fear.

brain  The human brain is the most complex organ of the human body. It contains an estimated 50 to 100 billion neurons. The scientific study of the brain and the nervous system is called neurobiology or neuroscience. The brain is part of the central nervous system, along with the spinal cord and the peripheral nervous system.

brain stem  The stem-like part of the base of the brain that is connected to the spinal cord. The brain stem controls the flow of messages between the brain and the rest of the body, and it also controls basic body functions such as breathing, swallowing, heart rate, blood pressure, consciousness, and whether one is awake or sleepy. The brain stem consists of the midbrain, pons, and medulla oblongata (MedicineNet.com, http://www.medterms.com/script/main/art.asp?articlekey=2517).

cerebral cortex  This is the outermost layer of the cerebral hemispheres of the brain and is primarily responsible for all forms of conscious experience, including perception, emotion, thought, and executive planning.

cerebral hemispheres  The two specialized halves of the brain that control different brain functions. For instance, in right-handed people, the left hemisphere is specialized for speech, writing, language, and math calculations. The right hemisphere is specialized for visual face recognition, music perception, and spatial abilities.

cognition  The process that allows a person to gain knowledge of or become aware of objects in his or her environment; the person then uses that knowledge for comprehension and problem solving.

coherece therapy  Formerly known as depth oriented brief therapy, was developed by Bruce Tucker and Laura Hulley. It is a system of experiential, empathic psychotherapy that uses memory reconsolidation techniques, permitting therapists to consistently promote deep shifts, dispelling clients' symptoms at their emotional roots often in a small number of sessions. The steps of coherence therapy correspond closely to the steps of the memory reconsolidation process brain researchers have identified.

dopamine  A catecholamine neurotransmitter that assumes various functions depending on where it acts. Dopamine is believed to regulate key emotional responses, such as reward, in the brain, and it plays a role in schizophrenia and drug abuse.

endorphins  Neurotransmitters produced in the brain that have cellular and behavioral effects similar to those of morphine.

forebrain  The largest part of the human brain; it contains the cerebral cortex and basal ganglia. The forebrain is responsible for the highest intellectual functions a human can perform.

frontal lobe  Contains our cognitive thinking, and this process shapes an individual's personality. The frontal lobe is made up of the anterior portion (prefrontal cortex) and the posterior portion, and it is separated from the parietal lobe by the central sulcus. Functions of the frontal lobe include reasoning, planning, organizing thoughts, behavior, sexual urges, emotions, problem solving, and judging.

gamma-amino butyric acid (GABA)  An amino acid transmitter in the brain whose major function is to inhibit the firing of nerve cells.

 glutamate  An amino acid neurotransmitter that functions to excite neurons.

hippocampus  A sea horse-shaped brain structure that is considered an important part of the limbic system. It is one of the most studied areas of the brain; it functions in learning, memory, and emotion.

inhibition  A synaptic message that prevents a neuron from firing.
**limbic system** A group of structures within the brain (including the amygdala, hippocampus, septum, basal ganglia, etc.) that help regulate the expression of emotion and emotional memory.

**long-term memory** The last phase of memory; it allows information to be stored that may last from hours to a lifetime.

**memory consolidation** The physical and psychological changes that occur when the brain organizes and restructures information to make it a permanent part of memory.

**neuron** May be defined as the electrically excitable cells that process and transmit information by electrical-chemical signaling.

**neuropsychotherapist** A psychotherapist who is thoroughly grounded in the knowledge of the neurobiological workings of the brain and other aspects of human biology and who uses this information in working therapeutically with clients.

**neuropsychotherapy** A psychotherapy practice that is informed by neuroscience and that is built on using a multidisciplinary approach that takes into account the whole individual.

**neurotransmitter** A chemical that is released from a nerve cell that transmits an impulse from one nerve cell to another.

**occipital lobe** The smallest of the four brain lobes. It is located in the rearmost portion of the skull and contains the primary visual cortex. Functions of the occipital lobe include visual reception, visual-spatial processing, movement, and color recognition. Disorders of the occipital lobe can cause visual illusions.

**parietal lobe** Responsible for integrating sensory information from various parts of the body. The optic nerve passes through the parietal lobe to the occipital lobe. Functions of the parietal lobe include information processing, movement, spatial orientation, speech, visual perception, pain, and touch sensation.

**serotonin** A monoamine neurotransmitter that plays a role in temperature regulation, sensory perception, and the onset of sleep. Neurons using serotonin are located in the brain and in the gut. Several antidepressant drugs are targeted to brain serotonin systems.

**short-term memory** A phase of memory in which a limited amount of information is held for several seconds or minutes.

**synapse** The structural space between neurons in the nervous system.

**temporal lobe** There are two temporal lobes, located at about the level of the ears on either side of the brain. The temporal lobes are responsible for auditory processing and are involved in hearing, speech, and memory.

### Website Materials

Additional exercises, journals, annotated bibliography, and more are available on the open-access website at https://study.sagepub.com/jonessmith2e.