The Developing Mind

How Relationships and the Brain Interact to Shape Who We Are

THIRD EDITION

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Supplemental Material

The mind is an embodied and relational process that regulates the flow of energy and information.

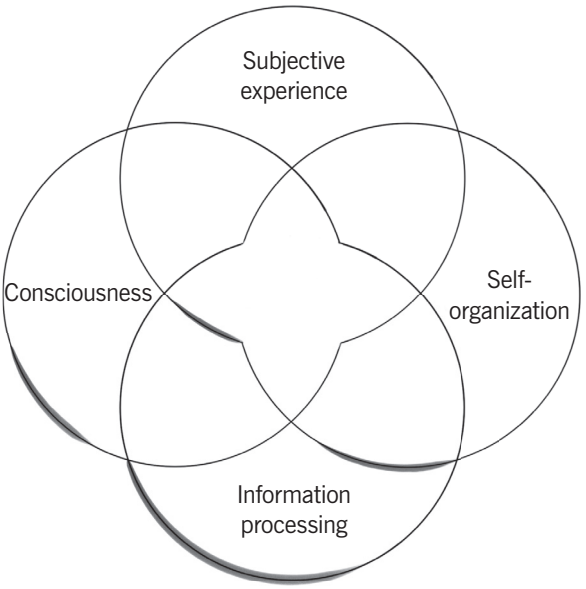

FIGURE I.1. Four facets of mind. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

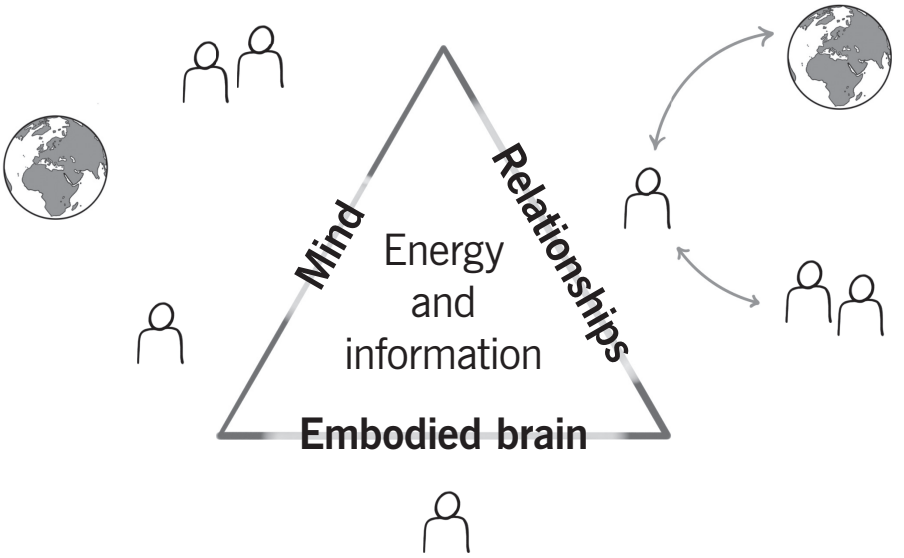

FIGURE I.2. Triangle of Human Experience. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

FIGURE I.3. River of Integration. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

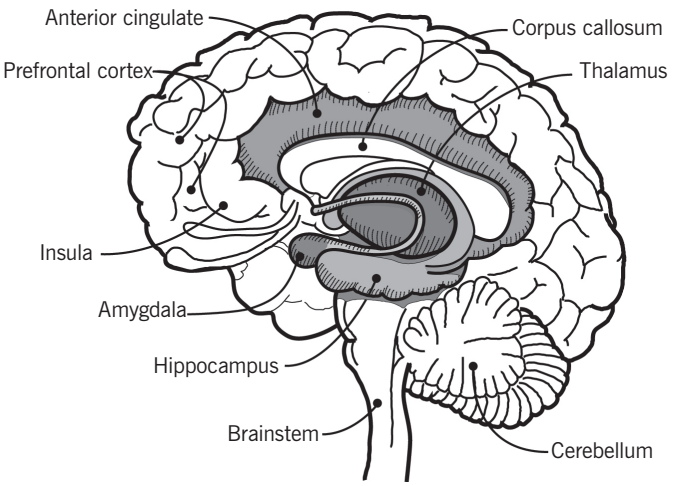

FIGURE 1.1. Diagram of the right hemisphere of the human brain. The lower areas include the cerebellum and the brainstem; the central areas include the limbic regions (amygdala, hippocampus) and thalamus; the upper areas include the cortical regions. The insula is beneath this medial surface.

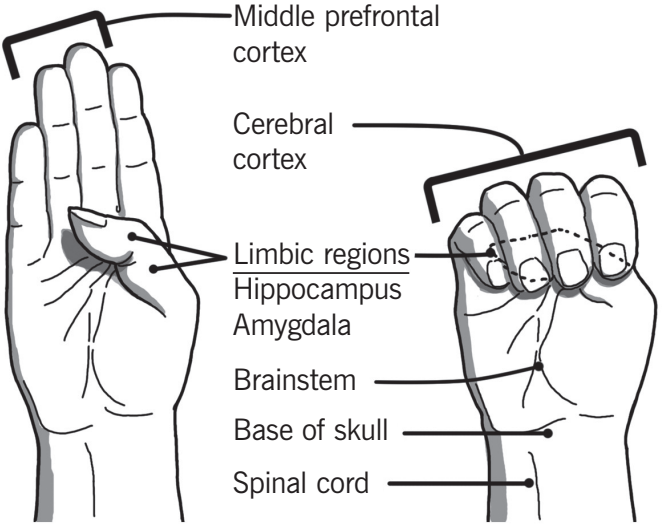

FIGURE 1.2. Hand model of the brain. Adapted from Siegel (2010a, p. 15). Adapted with permission from Bantam Books. Copyright © 2012 Mind Your Brain, Inc.

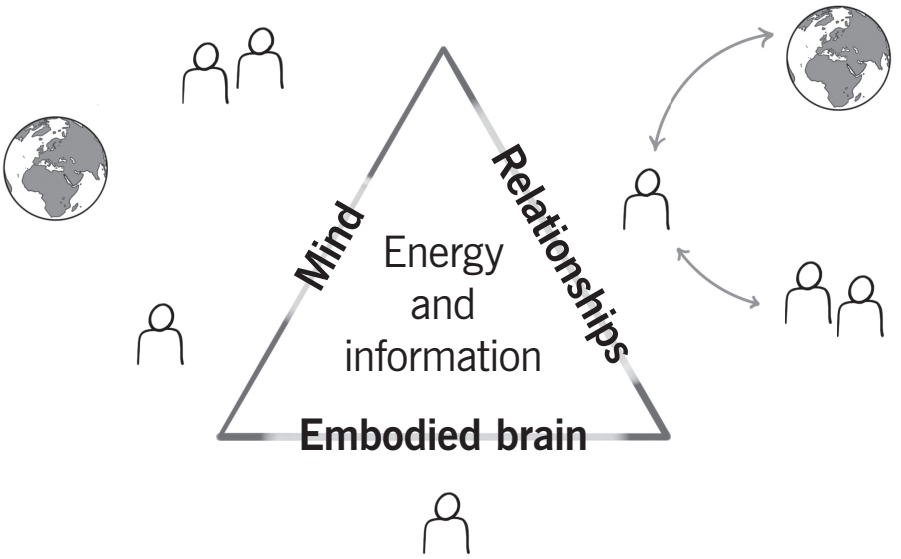

FIGURE 1.3. Triangle of Human Experience. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

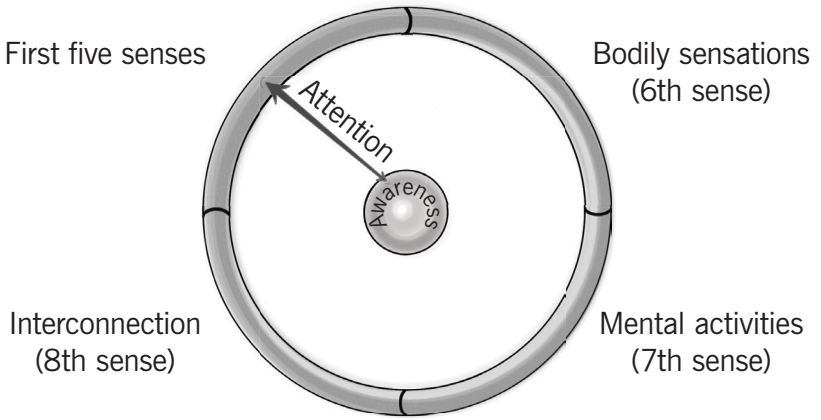

FIGURE 1.4. Wheel of Awareness. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

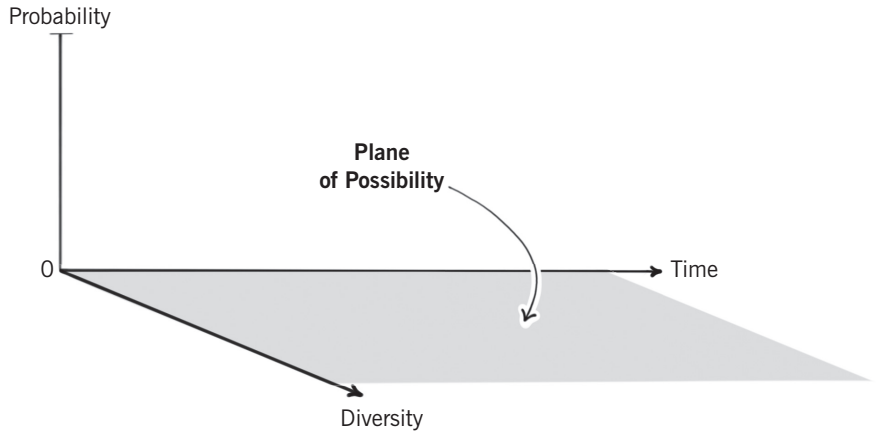

FIGURE 1.6. Three-P diagram: plane of possibility. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

five. This can be seen as point C at an elevated point of increased probability (one out of five is greater than one out of one million). Then once I indicate, Atlantic Ocean, we move to C-1 and the subset of five possible words at C has moved to actualization at C-1.

9. We can now label these three distinct positions as the maximal possibilities in the *plane,* the elevated probabilities in what we will call a *plateau,* and the actualization of possibility into actuality as a *peak*. Because of these

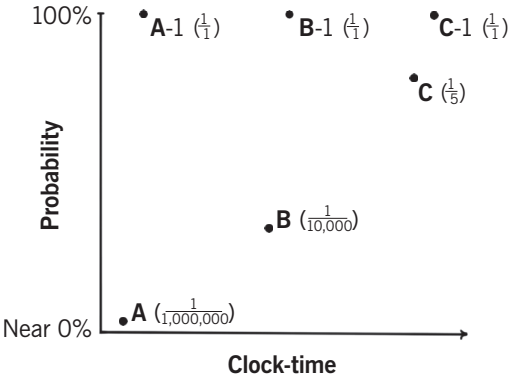

FIGURE 1.7. Graphing probability. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

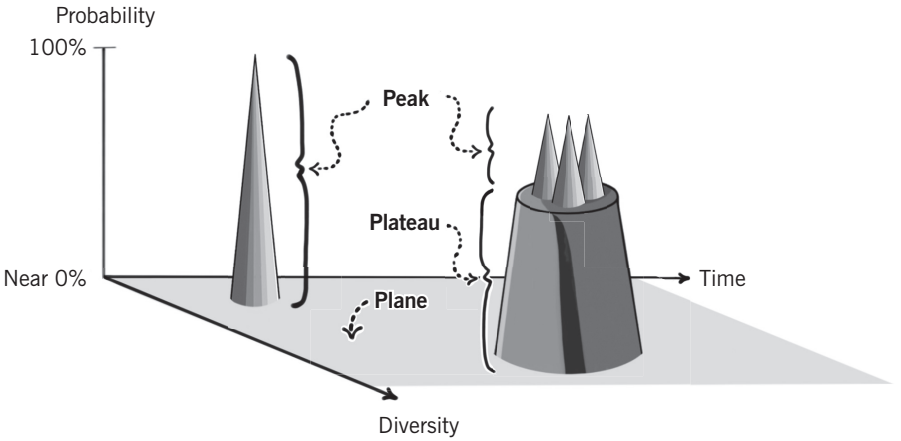

FIGURE 1.8. Three-P diagram: peaks, plateaus, and plane. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

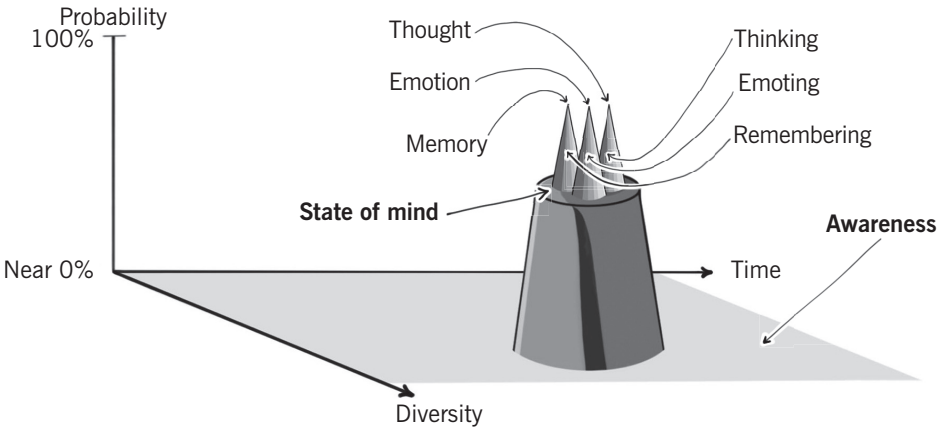

FIGURE 1.9. Three-P diagram with state of mind. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

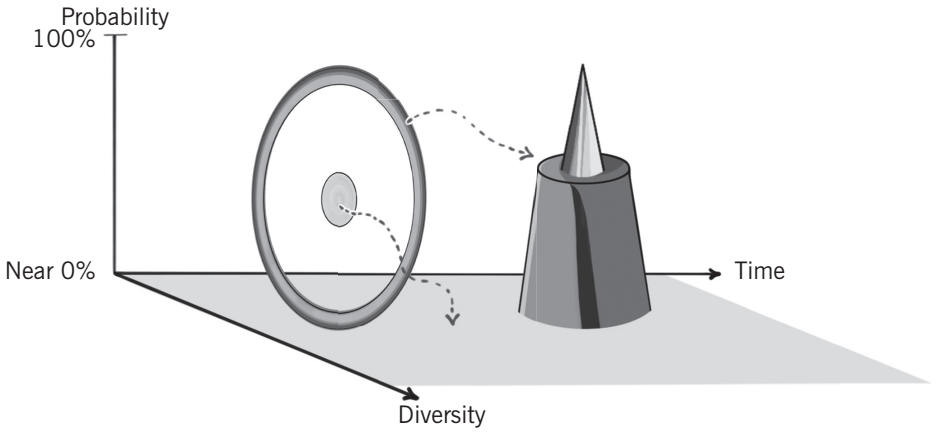

FIGURE 1.10. Three-P diagram meets the Wheel of Awareness. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

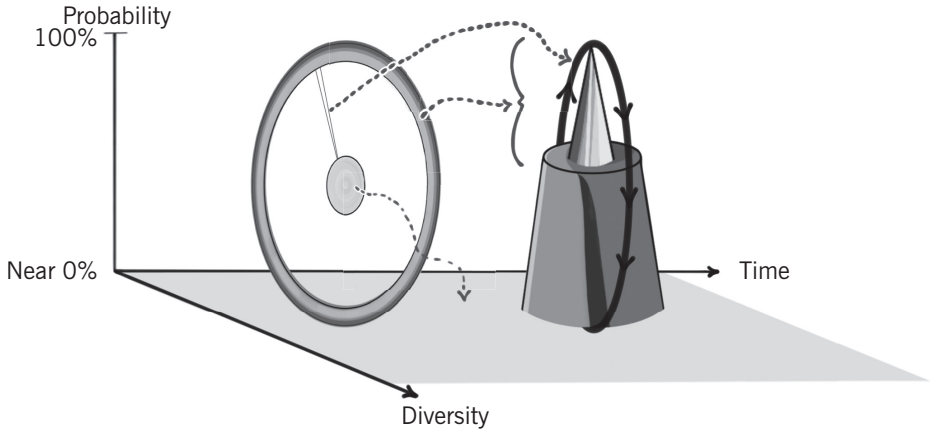

FIGURE 1.11. Three-P diagram and loop of attention. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

TABLE 1.1. Correlates of Mind

Mind as subjective experience	Wheel of Awareness metaphor	Three-P diagram and mechanism	Neural correlation/ brain activity	Other terms related to mental life
Awareness	Hub	Plane	High integration	Consciousness
Focal attention	Spoke of attention	Loop of sweep	40 Hz sweep from thalamus to cortex	Concentration
Sensation (*first five* and the *sixth sense* of the body)	First two segments of rim	Peaks of activation with minimal filtering	Lateralized brain regions active, including sensory cortices and insula	Conduition
Mental activities (*seventh sense*)	Third segment of rim	Peaks often arising from plateaus	Cortical regions, including midline default mode network (DMN)	Construction
Sense of interconnection: relational connections felt as conduition and construction (*eighth sense*)	Fourth segment of rim	Peaks directly arising from plane and/or plateaus	Memory and/or resonance with energy states from other people and environment: the external inputs of an open system	Connection experienced as conduition and construction

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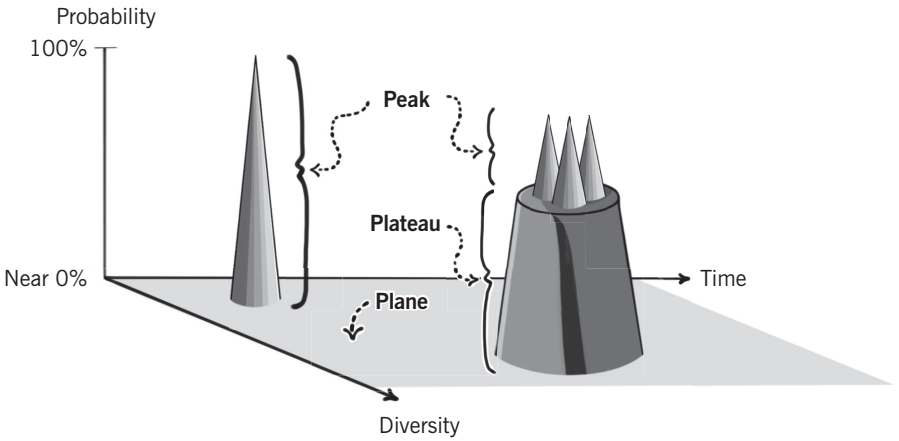

FIGURE 2.1. Three-P diagram with plateaus, peaks, and plane. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

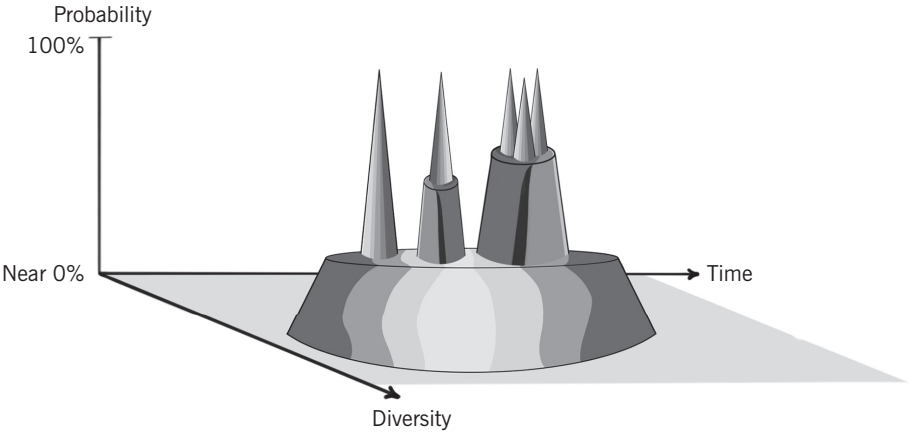

FIGURE 2.2. Three-P diagram with low-lying plateau. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

TABLE 3.1. Implicit and Explicit Memory

Implicit memory
Early form of memory—present before birth.
Devoid of the subjective internal experience of "recalling," of self, or of time.
Involves mental models and "priming."
Includes behavioral, emotional, perceptual, and somatosensory memory.
Focal attention *not* required for encoding.
Mediated via brain circuits involved in the initial encoding and independent of the medial temporal lobe/hippocampus.
Explicit memory
Late memory—present beginning in first year of life:
Semantic (factual) memory: Initial development by one to two years of age.
Autobiographical (collections of episodic memory): Progressive development with onset after second year of life.
Requires conscious awareness for encoding and having the subjective sense of recollection (and, if autobiographical, of self and time).
Focal attention required for encoding.
Hippocampal processing required for storage and initial retrieval.
Cortical consolidation makes selected events a part of permanent memory and independent of hippocampal involvement for retrieval.

in the world across time. The brain's ability to create such a temporal and spatial representation is clearly of great survival value. Explicit memory plays the important role of providing a sense of space and time, allowing people to remember where things are and when they were there.

Paller, Voss, and Westerberger have stated:

> Models of declarative memory generally posit that these distinct features or fragments must become linked together for enduring memory storage to be successful. Retrieval, rehearsal, and consolidation would thus entail synchronous activation across dispersed cortical networks, and this synchronous cross-cortical activity may be of the same type necessary for conscious experience more generally.[44]

In this way, we can see how the emergence of consciousness as development progresses may be intimately related to the development of memory. Both memory and consciousness depend upon integrative processes in the brain for their creation. This linkage of differentiated elements can also be seen in how energy and information are shared within relationships with caregivers and in the larger communities of interconnected relationships in which we live.[45] Memory has been shown, for example, to be influenced by the use of language within the communication patterns of both the microculture of a family and the macroculture of our larger society.[46] In these ways, the conscious

The emergence of consciousness may be intimately related to the development of memory.

TABLE 4.1. AAI Classifications and Corresponding Patterns of Infant Strange Situation Behavior

Adult state of mind with respect to attachment	Infant Strange Situation behavior
Secure/autonomous (F)	Secure (B)
Coherent, collaborative discourse. Valuing of attachment, but seems objective regarding any particular event/relationship. Description and evaluation of attachment-related experiences is consistent, whether experiences are favorable or unfavorable. Discourse does not notably violate any of Grice's maxims.	Explores room and toys with interest in preseparation episodes. Shows signs of missing parent during separation, often crying by the second separation. Obvious preference for parent over stranger. Greets parent actively, usually initiating physical contact. Usually some contact maintaining by second reunion, but then settles and returns to play.
Dismissing (Ds)	Avoidant (A)
Not coherent. Dismissing of attachment-related experiences and relationships. Normalizing ("excellent, very normal mother"), with generalized representations of history unsupported or actively contradicted by episodes recounted, thus violating Grice's maxim of quality. Transcripts also tend to be excessively brief, violating the maxim of quantity.	Fails to cry on separation from parent. Actively avoids and ignores parent on reunion (i.e., by moving away, turning away, or leaning out of arms when picked up). Little or no proximity or contact seeking, no distress, and no anger. Response to parent appears unemotional. Focuses on toys or environment throughout procedure.
Preoccupied (E)	Resistant or ambivalent (C)
Not coherent. Preoccupied with or by past attachment relationships/experiences, speaker appears angry, passive, or fearful. Sentences often long, grammatically entangled, or filled with vague usages ("dadadada," "and that"), thus violating Grice's maxims of manner and relevance. Transcripts often excessively long, violating the maxim of quantity.	May be wary or distressed even prior to separation, with little exploration. Preoccupied with parent throughout procedure, may seem angry or passive. Fails to settle and take comfort in parent on reunion, and usually continues to focus on parent and cry. Fails to return to exploration after reunion.
Unresolved/disorganized (U/d)	Disorganized/disoriented (D)
During discussions of loss or abuse, individual shows striking lapse in the monitoring of reasoning or discourse. For example, individual may briefly indicate a belief that a dead person is still alive in the physical sense, or that this person was killed by a childhood thought. Individual may lapse into prolonged silence or eulogistic speech. The speaker will ordinarily otherwise fit Ds, E, or F categories.	The infant displays disorganized and/or disoriented behaviors in the parent's presence, suggesting a temporary collapse of behavioral strategies. For example, the infant may freeze with a trance-like expression, hands in air; may rise at parent's entrance, then fall prone and huddled on the floor; or may cling while crying hard and leaning away with gaze averted. Infant will ordinarily otherwise fit A, B, or C categories.

Note. From Hesse (1999b, p. 399). Copyright © 1999 The Guilford Press. Reprinted by permission. Descriptions of the Adult Attachment Classification System are summarized from Main, Kaplan, and Cassidy (1985) and from Main and Goldwyn (1984, 1998). Descriptions of infant A, B, and C categories are summarized from Ainsworth, Blehar, Waters, and Wall (1978), and the description of the infant D category is summarized from Main and Solomon (1990).

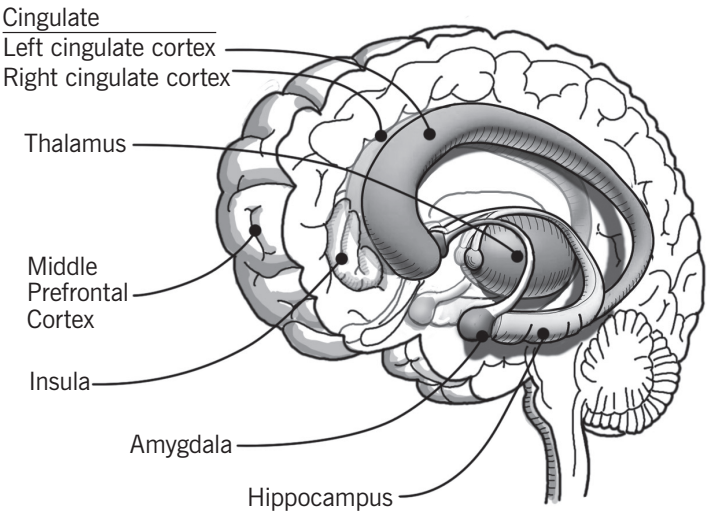

FIGURE 5.1. Appraisal centers of the brain in the distributed limbic areas. The insula is a broad band beneath this medial surface.

FIGURE 7.1. River of Integration. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

FIGURE 9.1. River of Integration bounded by the banks of chaos and rigidity. Illustration by Madeleine Welch Siegel. From *Aware: The Science and Practice of Presence* by Daniel J. Siegel. Copyright © 2018 Mind Your Brain, Inc. Used by permission of TarcherPerigee/Penguin Random House.

Glossary

Action potential: The process of the neuron in which charged particles, or ions, flow in and out of the membrane to create the equivalent of an electric flow down the long axonal length of the neuron.

Adolescence: The period of development in a range of animals that involves the transition from childhood dependency to adult responsibility.

Affect: The way an internal emotional state is externally revealed. Also called "affective expression."

Affect regulation: The mechanisms by which emotion and its expression are modulated.

Alignment: The process by which the internal state of one person is altered to reflect the internal state of another individual.

Allostatic load: The current sum of stresses experienced by an individual.

Amygdala: Part of the centrally located limbic regions of the brain. This almond-shaped cluster of neurons is involved in the appraisal of meaning, the processing of social signals, and the activation of emotion. Along with the orbitofrontal cortex and anterior cingulate, it plays a crucial role in coordinating perceptions with memory and behavior.

Anterior cingulate cortex: A curved structure at the top of the limbic area/bottom of the prefrontal region that coordinates a number of processes, including the focus of attention, the registration of bodily states (such as pain), and the social representation of interactions (such as rejection).

Anterior insula: The frontmost part of the **insula** (see below). It serves as a ventrolateral prefrontal region that transfers information in a vertical fashion between the cortex and the subcortical regions, including the limbic areas and the body proper.

Apoptosis: The diminution or pruning of synaptic connections in the absence of stimulating experience. Also called **parcellation.**

Appraisal–arousal: The second phase of an emotional response, following initial orientation and preceding the creation of categorical emotion.

Attention: The process that regulates the flow of information. Attention can be within awareness as "focal attention," or it can be outside of awareness as "nonfocal attention."

Attractor states: Reinforced patterns or activated states of mind that are fairly stable in specific conditions or contexts. These states "attract" particular neuron firing patterns that then reinforce their own creation. Attractor states constitute a way that a system organizes itself and achieves stability in the moment.

Autonoesis/autonoetic consciousness: Self-knowing awareness, associated with episodic and autobiographical memory and connected to "mental time travel"—the linkage of past, present, and anticipated future.

Autonomic nervous system: A system extending from the head down into the body; it regulates heart rate, respiration, and other bodily functions. Sometimes abbreviated as "ANS." A basic view of the ANS is that it consists of two branches, a sympathetic branch (the "accelerator") and a parasympathetic branch (the "brakes"). See also **sympathetic nervous system** and **parasympathetic nervous system.**

Awareness: The mental experience of consciousness. Awareness involves a sense of knowing and enables us to become conscious of the knowns of life, from sensation to cognition.

Axon: A long portion of a neuron, which extends from the cell body out to make synaptic connections with other neurons.

Basal ganglia: A set or cluster of neurons beneath the outer cortex, thought to mediate rule-guided behavior.

Brain: Here viewed as the extended nervous system distributed throughout the entire body and intimately interwoven with the physiology of the body as a whole. It is the embodied neural *mechanism* that shapes the flow of energy and information.

Brainstem: A lower brain structure, deep within the skull. It mediates states of arousal and alertness, and regulates the physiological state of the body (temperature, respiration, heart rate). It also houses the clusters of neurons that activate the fight–flight–freeze-faint survival reactions.

Categorical affects: The external expressions of categorical emotions.

Categorical emotions: The third stage of an emotional response that involves differentiation of initial orientation and appraisal–arousal. Sadness, anger, fear, surprise, and joy are examples of categorical emotions. See also **emotions** and **primary emotions.**

Cell membrane: The protein–lipid layer surrounding the cell. For the nervous system, the cell membrane functions to transfer electrochemical energy flow in the form of an action potential (ions flowing in and out of neuron through the membrane) and chemical release via neurotransmitters at the far end of the axon.

Central nervous system: The components of the nervous system, such as the skull-enclosed part of the brain, that connect with the peripheral nervous system (which is spread throughout the body). Sometimes abbreviated as "CNS."

Cerebellum: A portion of the brain at the back of the skull that plays an important role in integrating bodily information with emotional and cognitive processing.

Circuit: A set of interconnected neurons that are linked by genetics and experience to carry out specific functions, such as perception or action.

Cognition: The processing of information. In philosophy, this process can be seen as embodied, enacted, extended beyond our individual body, and embedded in the world surrounding us.

Coherence: The fluid and adaptive flow of integrated elements across time. Coherence is created across states of mind as a form of diachronic (across-time) integration.

Cohesion: The quality of elements sticking together. Cohesion exists within a given state of mind as a form of synchronic (in-the-moment) integration. Cohesive states of mind can be highly functional and responsive to the environment, but if they are excessively rigid and not flexible across time, they can lead to dysfunctional reactions.

Compassion: The capacity to sense suffering, to imagine what might be done to reduce that suffering, and to take effective action toward that purpose. Compassion can be directed toward one's inner experience—sometimes called "self-compassion"—as well as toward others in what is sometimes called "other-directed" compassion. These two directions in the flow of compassion can also be called "inner compassion" and "inter compassion."

Conceptual (or categorical) representations: Prelinguistic representations that symbolize the mind's creation of ideas, such as notions about the mind itself. They have no direct correlates in the external, three-dimensional world and so are abstract—for example, freedom or compassion.

Connectome: The interconnected networks of the brain located within the head. The degree of linkage of the differentiated parts of the connectome has been found to be correlated with well-being, whereas impairments to this integrated state have been associated with impediments to health.

Connectome harmonics: The oscillations of neural firing in waves of energy patterns that interconnect widely separated regions into a functional whole.

Consciousness: The subjective experience of being aware and being aware of that which we ponder—the knowing and the knowns. It has at least two dimensions: access to information, and the phenomenal or subjective personal quality of an experience. See also **awareness.**

Consilience: The discovery of common findings from independent disciplines. The term was popularized by E. O. Wilson in 1998. Consilience is the intellectual approach to the field of IPNB.

Constraints: Factors that are modified by complex systems in order to balance continuity and flexibility. Constraints are internal (e.g., synaptic strengths) and external (e.g., interpersonal relationships). Constraints form the context that shapes the mind.

Contingent communication: A way in which the signals of one person are (1) perceived, (2) made sense of, and (3) responded to in a timely and effective manner. They are based on affect attunement and sensitivity to another's nonverbal signals.

Corpus callosum: The connecting fibers that link the left and the right hemispheres of the brain.

Cortex: See **neocortex.**

Cortical consolidation: The process by which encoded memories are integrated into cortical representations for long-term storage and are then free from dependence on the hippocampus for retrieval. It may be a fundamental outcome of dreaming and sleep.

Corticosteroids/cortisol: Sometimes known as the "stress hormone," cortisol is released during stress to alter metabolism in an adaptive manner.

Default mode network (DMN): The mostly midline areas of the brain that, when activated, involve a common resting state of brain function that is present when an individual is given no task to perform. The DMN is involved in a range of functions from "mind wandering" to autobiographical reflections and creating maps of the individual's mind for insight and of other people's minds for empathy.

Dendrites: The receiving ends of neurons.

Dorsal: A term referring to the back of something, as opposed to the ventral side. See also **ventral.**

Dorsal dive: The activation of the dorsal branch of the primitive vagal nerve, in which blood pressure and heart rate both drop when a sense of helplessness arises and a flaccid freeze or feigned death response is engaged. It can lead to fainting.

Ecphoric sensation: A feeling that a recalled memory is accurate, whether or not it is. Ecphoric sensations give the signal that something is coming from the past. *Déjà vu* may be an example of a neurologically activated ecphoric sensation in the absence of accurate recall.

Ecphory: The process of reactivating explicit memory when there is a match between retrieval cue and memory representation.

Elaborative appraisals: Brain processes that assess whether a stimulus is "good" or "bad," and that determine whether an organism should move toward or away from the stimulus.

Emergence/emergent property: A process arising from the interactions of a complex system's basic parts. Emergence makes the whole greater than the sum of its parts.

Emotion regulation: See **affect regulation.**

Emotions: Changes in the state of integration. Within the brain, an emotion links various systems together to form a state of mind. It also serves to connect one mind to another. Emotional processing prepares the brain and the rest of the body for action, to "evoke motion." See also **primary emotions** and **categorical emotions.**

Empathy: The capacity to make a map of another's mental state that includes at least the five functions of emotional resonance, perspective taking, empathic understanding, empathic joy, and empathic concern. For most individuals, empathy is a requirement for compassion. Integration (see below) enables empathic connection to be harnessed without losing differentiation and fusing with another's experience.

Encoding: The process by which neural activation during experience alters synaptic strengths.

Energy: A term from physics that refers to the capacity to do something. Another view is that energy is the movement from possibility to actuality. Energy comes in various forms, such as kinetic, thermal, nuclear, electrical, and chemical. The nervous system functions by way of the flow of electrochemical energy. The flow of energy and a subset of energy, information, is a primary focus of an IPNB view of mind.

Engram: The initial impact of an experience on the brain; the encoding of a new memory.

Ephaptic coupling: The process of direct communication between neurons that does not involve neurotransmitters.

Epigenesis: The process in which experience alters the regulation of gene expression by way of changing the various molecules (histones and methyl groups) on the

chromosome. Some epigenetic changes can be passed through the sperm and egg to the next generation.

Episodic memory: The encoding, storage, and retrieval of a sense of self as experienced in one specific episode of time.

Experience-dependent: The form of neural growth in which novel experience induces the activation of genes to create the proteins that result in new synapse formation or synapse strengthening.

Experience-expectant: The form of neural growth in which synapses grow on the basis of genetic information, and the maintenance of these synapses relies upon the exposure of the organism to "expected" stimuli, such as light, sound, or caregiving. Lack of such stimuli leads to the loss of these genetically established connections.

Explicit memory: The layer of memory that during recall is coupled with an internal sensation of remembering. There are two forms: **semantic memory** (factual) and **episodic memory** (with repeated episodes being called "autobiographical"). The encoding or deposition of explicit memory requires focal, conscious attention. Without focal attention, or with excessive stress hormone (cortisol) release, items are not encoded explicitly but are encoded in implicit form.

FACES: flexible, adaptive, coherent, energized, and stable

Frontal lobes: The lobes at the front of the cerebral cortex; they make linkages among widely distributed processes fundamental to higher thinking and planning.

Gene expression: The process by which information on the chromosome, a gene, is transcribed into RNA and then translated into proteins so that changes in anatomic structure can be created. For the nervous system, gene expression leads to synaptic growth. Epigenetic factors regulate gene expression.

Glial cells: Fundamental cells of the nervous system, numbering in the trillions; they are generally smaller than neurons and carry out a number of functions that support neurons through myelin production and regulating blood flow. The microglia cells also perform important immune system functions to regulate degrees of inflammation, and they participate in the repair and growth of neurons and their connections in the brain.

Hippocampus: Located in the central part of the brain, this seahorse-shaped structure is a part of the medial temporal lobe limbic area. The hippocampus plays a central role in flexible forms of memory, in the recall of facts and autobiographical details. It gives the brain a sense of the self in space and in time, regulates the order of perceptual categorizations, and links mental representations to emotional appraisal centers.

Hypothalamic–pituitary–adrenocortical (HPA) axis: A system that responds to stress and its function over time, which can be adversely affected by trauma.

Hypothalamus: Located in the lower region of the brain, near the pituitary, this structure is responsible for physiological homeostasis as a master hormone regulator.

Implicit memory: Involves parts of the brain that do not require conscious, focal attention during encoding or retrieval. Perceptions, emotions, bodily sensations, and behavioral response patterns are all examples of implicit layers of processing. Mental models (schema or generalizations of repeated experiences) and priming (getting ready to respond) are basic components. Implicit memory in its unintegrated form does not convey a sense that something is being recalled from the past.

Information: Patterns of energy that have symbolic meaning. Information is also an active process, in that it gives rise to further processing in cascades of associations and linked meanings that emerge over time.

Insula: A structure in the ventrolateral prefrontal cortex that links bodily processes to higher cortical areas. Information from the body streams up the spinal cord's Lamina I and reaches to the brainstem and then the insula. First the dorsal and then the right anterior part of the insula seem to be involved in the process of **interoception** (see below). The direct link of the insula to other prefrontal areas, such as the anterior cingulate, by way of spindle cells has been associated with forms of self-awareness.

Integration: In general, the linkage of differentiated elements. The mind's process of linking differentiated parts (distinct modes of information processing) into a functional whole is postulated to be the fundamental mechanism of health. Without integration, chaos, rigidity, or both ensue. Integration is both a process and a structural dimension, and can be examined, for example, in the functional and anatomic studies of the nervous system. Note: Some neuroscientists use the term, "integration" to signify linkage and "segregation" to indicate differentiation.

Internal working model: A mental model derived from experiences. Repeated interaction with an attachment figure shapes a child's mental models and expectations for future interactions. These working models are open to change throughout the lifespan.

Interoception: The ability to know what we are feeling—to become aware of internal bodily states and affective arousal. This awareness seems to involve action of the right anterior insula in the prefrontal cortex and is correlated with the capacity for empathy for the feelings of others.

Interpersonal neurobiology (IPNB): A consilient field that embraces all branches of science and now other disciplined ways of understanding reality, such as contemplative traditions and the liberal arts, as it seeks the common, universal findings across independent ways of knowing in order to expand our understanding of the mind and well-being.

Lateral prefrontal cortex: Also known as the "dorsolateral prefrontal cortex," this region is thought to be a primary center for mediating executive functions such as focal attention as it links to activities in other regions of the brain.

Limbic regions: Located in the central part of the brain called the medial temporal lobe, these areas include the amygdala and hippocampus; they coordinate input from the higher cortical regions, with streams of input from the lower brainstem and the body proper. Limbic structures permit integration of a wide range of mental processes, such as appraisal of meaning, processing of social signals, and the activation of emotion. The limbic area emerged during our mammalian evolution and is thought to be essential for attachment. As it is extensively connected to many areas, some researchers do not consider this a "system" but rather a general set of regions in the brain.

Long-term potentiation: A way in which the firing of neurons strengthens their synaptic connections to one another and increases the probability that the pattern will be repeated. Sometimes abbreviated as "LTP." This is one process by which experience leads to structural changes in the linkages among neurons during the encoding of events into long-term memory.

Memory: The way past events affect future function; the probability that a particular neural network pattern will be activated in the future. See also **implicit memory** and **explicit memory.**

Mentalization: The ability to understand one's own and other people's minds; a form of **metacognition** (see below). It is also related to theory of mind, mind-mindedness, mind perception, psychological-mindedness, reflective function, and aspects of **mindsight.**

Metacognition: A form of "thinking about thinking" that starts developing in the early years of life. It includes learning that there is a distinction between actual reality and the appearance of reality (the "appearance–reality distinction"); that feelings influence thinking and behavior (part of "emotional intelligence"); that what you believe and perceive and what I believe or perceive may both have validity but be different ("representational diversity"); and that what we believe at this moment may change in the future ("representational change").

Microbiome: The composition of non-human organisms in the intestinal system that include bacteria and fungi that research has revealed directly impact the functioning of the brain.

Microglia: The very small glia cells that are derived not from neural origins but from the immune system. Other glia include the Schwann cells, oligodendrocytes, and astrocytes. The microglia may have crucial functions in the immune and inflammatory responses within the brain.

Midline or middle areas of the prefrontal cortex: A portion of the cerebral cortex consisting of medial, ventral, orbitofrontal, and anterior cingulate cortices. The neural circuits in this interconnected set of regions function to integrate the processing of social information, autobiographical consciousness, the evaluation of meaning, the activation of arousal, bodily response, and higher cognitive processing. Nine middle prefrontal functions are body regulation, attuned communication, emotional balance, fear modulation, flexibility of response, insight, empathy, morality, and intuition. These are the outcomes of mindfulness meditation practice and (the first eight) of secure attachment relationships.

Mind: A process that includes at least four fundamental aspects: (1) personal, subjective experience; (2) awareness; (3) information processing; and (4) a regulatory function that is an emergent, self-organizing, embodied and relational process of the extended nervous system and relationships. This facet of a core aspect of mind offers a working definition of "mind" as an embodied and relational process that *regulates* the flow of energy and information. In this perspective, the brain's activity is an important part of mind, but mind is broader than the brain and bigger than the individual body. Mind is fully embodied and fully relational.

Mindful awareness: Awareness of present-moment experience, with intention and purpose, without grasping at judgments. It includes having an open stance toward oneself and others, emotional equanimity, and the ability to describe the inner world of the mind.

Mindsight: The ability to see the internal world of self and others, not just to observe behavior. It is the way we not only sense but also shape energy and information flow within the triangle of mind, brain, and relationships and move that flow toward integration. Using mindsight, integration made visible is kindness and compassion.

Mindsight maps: Creating representations of the mind within the mind. Three such mindsight maps are of "me" (insight), "you" (empathy), and "we" (a sense of belonging to a larger whole).

Modality: An organizational functional process of the brain that links similar representation modules into a mode, such as those involving visual perception to form the visual

mode. Modes or modalities can themselves be coordinated to form a "system"—in this case example, a system of cross-modality perception linking vision with hearing.

Module: A set of neural circuits carrying a certain type of (usually localized) information and using a similar form of neural signal or code. Modules can be linked together to form a mode; modes come together to form a system.

Mood: The general tone of emotions across time. A bias in the system toward certain categorical emotions. Mood shapes the interpretation of perceptual processing and gives a "slant" to thinking, self-reflection, and recollections.

MWe: A term embedding two aspects of identity from the equation, Me plus We = MWe. MWe is a linguistic symbol integrating the differentiated internal and relational aspects of the mind.

Myelin: The fatty sheath created by glial cells that forms insulation around the long axonal lengths of neurons, so that the speed of neuronal firing is increased one hundred times and the resting or refractory period is decreased by thirty times. As a result of practice, myelin thus increases the effective communication among interconnected neurons by three thousand times, creating the enhanced functioning necessary for skill building.

Neocortex: Also known as the **cortex** (or "cerebral cortex"), this is the outer layer of the cerebral hemispheres. It consists of highly folded layers, usually about six cells deep, filled with "cortical columns" of highly linked neuronal clusters. Their communication with other columnar areas allows more and more complex functions to emerge. The neocortex mediates information-processing functions, such as perception, thinking, and reasoning.

Neural integration: Linkage of differentiated neurons within the brain that results in optimal self-regulation via the balancing and coordination of disparate regions into a functional whole. In various neuroscience approaches, a slightly different nomenclature is used for a similar process. These alternative terms include "segregation" (for our term "differentiation") and "integration" (for our term "linkages"). Another set of terms involves the connectome (see above) and uses the phrase of "interconnected connectome" to refer to those differentiated areas of the brain that are functionally or structurally linked.

Neural net profile: The recruitment of various activated neuronal circuits into a localized memory representation or, more globally, into a state of mind.

Neural network: A set of interconnected neurons.

Neural pathways: A term used to denote the functional linkage of neural circuits.

Neurobiology: The study of how neurons work and how the nervous system functions.

Neuron: A basic type of cell in the nervous system. It is consists of a cell body, receiving ends called **dendrites,** and a long **axon** that reaches out to other neurons at a synaptic linkage. Four types of glia cells surround and interact with the neurons and are smaller and far more numerous.

Neuroplasticity: The overall process by which brain connections are changed by experience, including the way we pay attention.

Noesis: A way of knowing that can include semantic knowledge as well as nonconceptual knowing; it is the sense we have of knowing about the world and about ourselves.

Orbitofrontal cortex: A part of the prefrontal cortex just behind the eyes. This important region is molded by relational experience and interacts with other aspects of the middle prefrontal cortex in shaping attachment and self-awareness.

Oscillations: The waves of electrical flow that pass through the brain and functionally connect a wide range of areas to one another. See also **connectome harmonics.**

Parallel distributed processing: The ability of a system such as the spider-web-like brain to process different types of stimuli simultaneously across different neural networks in a rapid and highly complex manner. Sometimes abbreviated as "PDP." PDP processors, animate or inanimate, can learn from experience.

Parasympathetic nervous system: One of two branches of the **autonomic nervous system.** The parasympathetic branch is inhibitory and de-arousing, producing, for example, decreases in heart rate, respiration, and alertness. See also **sympathetic nervous system.**

Parcellation: The pruning of synaptic connections. Also called **apoptosis.**

Perceptual representations: Constructed bits of information created from the synthesis of present sensory experience with past memory and generalizations contained in experientially derived mental models. These representations are the essence of top-down processing, in that what we perceive is shaped by our past experiences.

Plane of possibility: A portion of a theoretical mechanism correlating with the Wheel of awareness (see below). The plane corresponds to the physics notion of a quantum vacuum or sea of potential, the mathematical "space" in which possibility rests before emerging as energy into actuality. The hypothesis presented here is that the plane of possibility corresponds to the hub of the Wheel of awareness, the experience of pure awareness.

Polyvagal theory: A theory posited by Steven Porges. According to this theory, humans have a reactive state of fight–flight–freeze–faint and a more receptive state that activates the "social engagement system" and makes the individual open to interacting with others. "Neuroception" is the process posited by this theory, which suggests that we are continually evaluating the context of a situation for its inherent threats to survival.

Prefrontal cortex: Central to the processes of creating meaning and emotion and of enabling a flexibility of response, it sits at the interface between lower regions (brainstem and limbic areas) receiving input from the body and higher regions (the cortex) involved in integrating information. It includes the dorsolateral prefrontal cortex; ventral areas such as the insula; and medial structures such as the orbitofrontal cortex, the ventromedial prefrontal cortex, and, in some frameworks, the anterior cingulate cortex.

Presymbolic representation: A neural net profile of activation from sensory input that is as close to the input as possible, with a minimum of top-down influences from prior experience. See also **sensory representation.**

Primary emotions: The shifts in brain state that result from the initial orientation and elaborated appraisal and arousal processes. Primary emotions are the beginning of how the mind creates meaning. They are not to be confused with categorical, or basic, emotions. See also **emotions** and **categorical emotions.**

Recruitment: A process that temporarily links distinct, differentiated elements into a functional whole. Emotions recruit distributed neuronal clusters to fire together into a cohesive state in the moment.

Recursive: The quality by which processes feed back on themselves to reinforce their own patterns of activation.

Reentry: A process by which positive feedback loops reinforce the initial patterns of activity, as in neural firing in the brain or in communication patterns within relationships. Reentry recursively stabilizes a neuronal firing pattern in that moment and allows the processing to become a part of conscious experience.

Reflective function: The ability of one person to perceive and reflect upon the mental world of the self and of other. The ability to create representations of the mind of oneself or another.

Remembering: The construction of a new neural net profile with features of the old engram and elements of memory from other experiences, as well as influences from the present state of mind.

Representations: Patterns of neural firing that serve as mental symbols. Different types of representation are processed in different parts of the brain. This term can be used for "neural representations" (neural net profiles that symbolize something) or for "mental representations" (the subjective experience of knowing something).

Resonance: The mutual influence of interacting systems on each other; it allows two or more entities to become a part of one functional whole.

Resonance circuits: Interconnected neural regions, including mirror neuron networks, which enable a person to tune in to others and align her internal states with others. The resonance circuits include the insula, which brings information down from the cortex to the limbic areas, the brainstem, and the body proper; then these lower inputs arise through the spinal cord to reach to the anterior insula and then to other areas of the medial prefrontal cortex, where mindsight maps of "me," "you," and "we" are constructed.

Response flexibility: The ability to respond flexibly and creatively to new or changing conditions instead of responding automatically and reflexively. Mediated by the midline areas of the prefrontal cortex, it allows the individual to pause and put a space between impulse and action.

Retrieval: The process of reactivating a neural firing pattern similar to, but never identical with, the engram first encoded for an experience.

Semantic memory: A form of explicit memory dealing with facts.

Sensory representation: The mental experience or neural firing pattern that contains information symbolizing sensations from the outside world, the body, and the brain itself.

Somatic maps: Representations in the brain of the physiological state of the rest of the body. A secondary somatic map is formed by the anterior insula from primary maps in the dorsal insula and allows us not only to be aware of the body's signals, but to pause and reflect on the body's input (interoception) and then do something intentionally to modify it.

State of mind: An overall way that mental processes, such as emotions, thought patterns, memories, and behavioral planning, are brought together into a functional and cohesive whole. A state of mind is shaped by the total pattern of activations in the brain at a particular moment. It coordinates activity in the moment, and it creates a pattern of brain activation that can become more likely in the future. States of mind allow the brain to achieve cohesion in functioning.

State-dependent: The process by which the context—internal and external—influences the functioning of a particular process.

Subcortical: A term referring to neural regions below the cortex, including the limbic areas and the brainstem in the skull portion of the nervous system, and sometimes also the neural processing of regions in the body proper.

Sympathetic nervous system: One of two branches of the **autonomic nervous system.** The sympathetic system excites and arouses, producing, for example, increases in heart rate, respiration, sweating, and states of alertness. See also **parasympathetic nervous system.**

Synapse: The linkage between two neurons. The synapse is often a small space between the end of one neuron's axons and the dendrites or cell body of another neuron; neurons communicate with each other through this space via the release of neurotransmitters from the presynaptic neuron and their reception by the receptors embedded in the membrane of the postsynaptic neuron.

Thalamus: A structure that sits atop the brainstem. It serves as a gateway for incoming sensory information and has extensive connections to other brain regions, including the neocortex. Activity of the thalamocortical circuit may be a central process for the mediation of conscious experience.

Ventral: Refers to the "belly side" of something, as opposed to the dorsal side. See also **dorsal.**

Vitality affects: The external expression of primary emotional states.

Wheel of awareness: A reflective practice that integrates consciousness using the metaphor of a wheel in which the hub represents the knowing of being aware and the rim contains the elements of the knowns, from the first five senses to mental activities such as emotions, thoughts, and memories.

Window of tolerance: A band of optimal functioning that flows between chaos on the side, and rigidity on the other. This flow emerges from integrative processes and has the features of FACES: being flexible, adaptive, coherent, energized, and stable.

Working memory: Holding something in the "front of the mind" for a brief period of time, so that the item can be the focus of attention, sorted, and altered for further information processing.