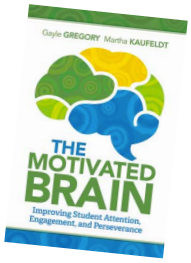


Seven Primary Emotional Networks (Processing Systems)

Affective neuroscientist Jaak Panksepp has labeled the most powerful of the seven systems as the SEEKING/EXPECTANCY system, and it includes *curiosity, interest, foraging, anticipation,* and *craving*. The other emotion systems (always printed in uppercase per Panksepp) to highlight their primary-process evolutionary organization of brain and mind) are FEAR, RAGE, LUST, CARE, GRIEF, and PLAY (Panksepp & Biven, 2012). The same types of neural pathways and neural chemistry that arouse each of these emotions are found in approximately the same areas of the brain within the various mammal species. Of course, the emotions felt by a dog are not exactly the same as a human's, and we should not expect them to be. but they are evolutionarily related. But by stimulating particular regions in the ancient subcortical regions of the brain, scientists can generate similar feelings and reactions in both humans and other mammals.

The seven primary systems include our raw emotional feelings, our instinctual emotional behaviors, and how our bodies move and react as each system is activated. They are not identical in their size or range. They do not work completely independently of one another. Each of the seven basic emotional systems can be located within every mammal's brain. In the same anatomical regions below the cortex and contain the same neurochemical controls.

Panksepp refers to the first four as the "blue-ribbon" core emotions. They are based on well-organized, consistent patterns of behaviors when the corresponding brain region is stimulated. These are inborn capacities of our brain. They are present at birth and are not dependent on experiences for development.

The "Blue Ribbon" Core Emotions

1. **SEEKING--Expectancy.** Stimulating the nucleus accumbens and the lateral hypothalamus, areas associated with the SEEKING System, will generate an urge to seek, expect, investigate, and be motivated. The specific neurotransmitters (or neuromodulators) associated with each emotion have also been identified. Dopamine (DA) is one of the main brain chemicals released when we are seeking, anticipating, and being motivated.

2. **FEAR--Anxiety.** When the amygdala and periaqueductal gray (PAG) areas of the brain are stimulated, the "fight, flight, or freeze" reaction will quickly emerge. Depending on the degree of the perceived threat, the response may range from cowering to running away in terror.

3. **RAGE--Anger.** When the medial area of the amygdala is stimulated, the animal will propel himself or herself forward to fend off the offensive object, and snarl or bite.

4. **LUST--Sexual excitement.** This primary emotion is generated in the amygdala and hypothalamus. When animals are in the throes of lust, they exhibit courting behaviors and

eventually attempt to culminate in mating behaviors. The tension of this emotion can become negative if satisfaction is elusive!

Additional Primary Emotions

5. **CARE--Nurturance.** When this system is aroused, an animal has strong impulses to tenderly take care of another. It is the source of our human emotion of love. This primary emotion is generated in the anterior cingulate and is fueled by the neurotransmitters oxytocin, prolactin, and opioids.

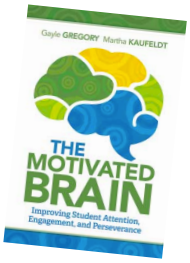
6. **PANIC/GRIEF--Sadness.** This primary emotion is often triggered by separation distress. When people and animals are enjoying secure affectionate bonds, they have a relaxed sense of contentment. When separated from the comfort of a caregiver or experiencing psychological abandonment, they will react with crying and sadness at the loss.

7. **PLAY--Social joy.** Playful and light-hearted movements and laughter characterize this primary emotion. It is a friendly enjoyment of interaction with others.

The SEEKING System: The "Granddaddy" of the Emotional Systems

Affective neuroscientists have spent decades mapping the location of these emotional systems of the brain that are shared by all mammals. Panksepp refers to the SEEKING system as the "granddaddy of the systems." This crucially important set of primary emotions is the motivational system that stimulates the foraging behaviors critical for survival. Survival needs are the ultimate trigger. The SEEKING system allows all mammals to find and eagerly anticipate the things they need for basic survival, such as food, a mate, and shelter. It is the instinctual drive that all mammals need in order to thrive. Our brains are wired to constantly restore *homeostasis,* the drive to maintain physical equilibrium. Homeostatic imbalances occur when we experience a lack of food, water, warmth, and other requirements for survival. Our brains trigger an urge to seek what we need in order to restore balance. The SEEKING system is in charge of maintaining homeostasis, but it also keeps us motivated and intensely interested in exploring our world, to learn as well as survive. It energizes our behaviors and attitudes, and Panksepp believes that it generates all motivation.

Rather than working under the construct that our "reward system" is triggered when we complete a task or finally achieve our intentions, the theory is that the SEEKING system provides us with continued enthusiasm, interest, and motivation while we are in the midst of processing. We feel good while we are *doing* the task, not just upon its completion. Dopamine provides us with a continued feeling of "wanting" as we seek, investigate, and research, and this is a *pleasurable* feeling. Survival needs are the ultimate trigger, as every creature strives to find and eagerly anticipates the things they need for basic survival. Dopamine increases our general level of arousal, inquisitiveness, and goal-directed behavior as we seek to fill those requirements.



The SEEKING System's Three Processing Systems

The SEEKING system has three basic processing levels (Wright & Panksepp, 2012). Understanding how each works will be of great help to classroom teachers. This book will take each one and illustrate how educators in classroom situations can enhance the likelihood of students developing curiosity, perseverance, and tenacity. Students' brains are programed to "seek and find," and teachers can enhance this need by planning strategically to engage the SEEKING system to maximize motivation.

The evolutionary three-level perspective of the SEEKING system helps us understand how an innate drive can lead to anticipation of future events, and ultimately to enthusiastic motivation and problem solving. The first most basic is called the *primary processing system*. The SEEKING system coordinates all incoming sensory information and generates an urge to see what resources might be available. When interactions with objects begin and discoveries are made, the *secondary processing system* launches and learned behavior begins. The *tertiary processing system* is the most advanced level of thinking and learning. As we grow and explore our environment, each of these systems is an integral part of the learning process.

Primary Processing

The very basic emotions emerging from deep in the brain that are instinctual, ancestral "memories" are what all mammals need in order to survive and are the essence of the primary processing system. These urges motivate us to seek out, find, and acquire all of the resources we may need to survive, without any formal teaching. It is the inner drive that keeps us moving forward, foraging, and enthusiastically investigating our environment. Beyond meeting our basic needs, we also are highly attracted to anything *novel* in the environment. Without any expectation of rewards, we vigorously explore everything and everyone around us. Animal behavior expert Temple Grandin (2010) refers to this as "the basic impulse to search, investigate and make sense of the environment. Panksepp says it's like a "goad without a goal" (Panksepp & Biven, 2012)

Secondary Processing

The foraging and exploration generated by the SEEKING System ultimately produces interactions with the environment. When resources are found and we are rewarded with nourishment, pleasure, play, social interactions, and new knowledge, our brains begin to make new dendritic connections. In essence, we are learning the benefits of *seeking.* The "wanting" system described by Pecina and Berridge (2013) would be considered a secondary process because there must have already been prior experiences that generated a "reward." The memory of the experience and outcome prompts the SEEKING system to continue to pursue a particular path, because there are memories of a pleasurable or satisfying prior experience.

Neuroplasticity describes how firsthand experiences reorganize our neural pathways, resulting in long-lasting changes in the brain's circuitry (Diamond & Hopson, 1998; see Figure 2.4). It was once believed that as we aged, the brain's networks became fixed. In the past two decades, however, an enormous amount of research has revealed that the brain never stops changing and adjusting.

Learning, as defined by Tortora and Grabowski (1996), is the ability to acquire new knowledge or skills through instruction or experience. Memory is the process by which that knowledge is

retained over time. The capacity of the brain to change with learning is plasticity. So how does the brain change with learning? According to Drubach (2000), at least two types of modifications occur in the brain with learning:

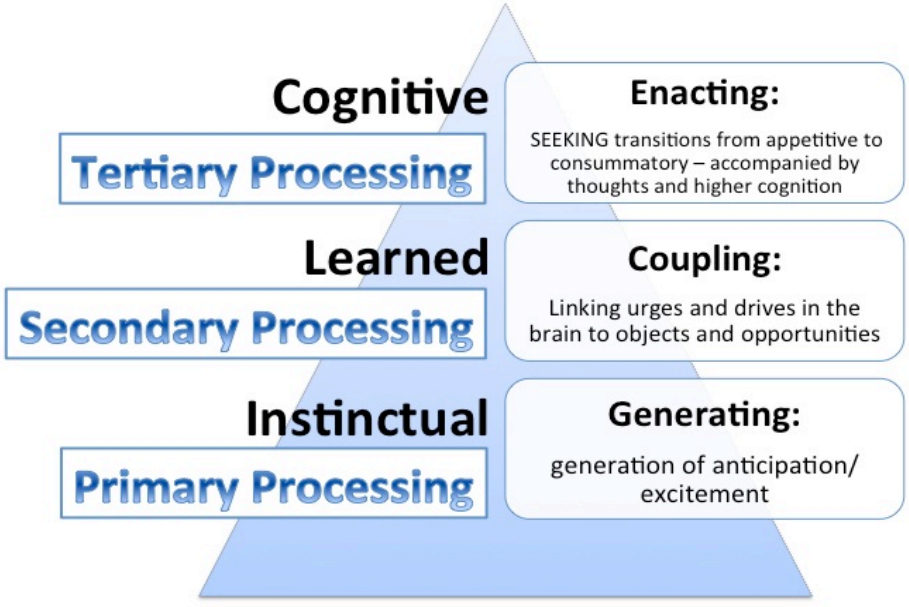
*A change in the internal structure of the neurons, the most notable being in the area of synapses
*An increase in the number of synapses between neurons

Now the generalized SEEKING system begins to anticipate possible rewards and resources. The brain begins to *learn* that certain conditions and cues may be worth investigating because it remembers great results from past interactions. This appetitive motivation and goal-oriented behavior occurs when the brain has memories and wishes to re-create the reward or experience.

If educators apply this understanding to the design of learning environments, students might experience greater anticipation and motivation. In Chapter X, we will explore how instructional design can be infused with opportunities for firsthand experiences and be based on motivating students by making connections to prior learning.

Tertiary Processing

The primary process drives are instinctual, unconditioned, and survival based. The secondary processes are when true learning begins to take place. Brains are growing and making connections as we are adapting to the environment, maximizing resources, understanding patterns, and developing memories. In humans the development of the cerebral cortex allows us to think and make connections at much higher levels. This tertiary processing develops with maturity, but it is also our ability to begin to think beyond the present, imagine, create, synthesize, and make cognitively sophisticated plans (Wright & Panksepp, 2012). Other executive functions in the neocortex include complex thinking, organizing, keeping track of time, strategizing, hypothesizing, and combining knowledge and ideas into new possibilities.



The SEEKING SYSTEM in the Classroom

For humans, this desire to search is not just about meeting our physical *s*urvival needs. Humans can get just as excited about abstract rewards as they can for tangible ones. Panksepp notes that the system seeks, and is attracted to, novelty, the anticipation of having fun, playing, and winning (achieving success). "It is evident that the SEEKING-EXPECTANCY system is a general-purpose system for obtaining all kinds of resources that exist in the world, from nuts to knowledge, so to speak" (Panksepp & Biven, 2012, p. 103).

In addition to prompting us to enthusiastically search for resources to meet our basic physical and emotional needs, the SEEKING-EXPECTANCY system also allows (urges) us to

*Experience the exciting feelings of *sustained anticipation* as we look forward to positive experiences and pleasurable activities;

*Develop *strategic thinking* and *higher mental processes* as we create hypotheses, make predictions, and fine-tune our expectations;

*Promote *optimistic behavior patterns* based on our memory of *prior successful experiences* that creates a want-to-do, and a can-do feeling;

*Engage in things that might make us *feel important, influential, powerful, and be honored by our peers;*

*Satisfy our attraction to *novelty* and *discrepancies.* "When a stimulus ceases to be novel (when the animal becomes accustomed to it) the SEEKING system no longer responds." (Panksepp & Biven, 2012, p. 106).

When we get thrilled about the world of ideas, about making intellectual connections, about making meaning, it is the SEEKING circuits that are activated. If, in fact, the SEEKING system underlies all positive motivation, tapping this system would be a key to success in classrooms. If educators can stimulate this system into action, they can trigger students' instinctual urge to get out there, do something, find answers, and learn!