The Outside Shapes the Inside:  
Neuroeducation and the Uniform Hieroglyphic of Transformative Learning

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Abstract

In *Leaves Of Grass*, Walt Whitman celebrates the myriad mysteries that define the human experience. Whitman suggests that the unifying commonality between all such mysteries is a “uniform hieroglyphic” of predictable wonderment.

Transformative learning theory, too, studies the consistent, yet often-cryptic experiences of perspective transformation—or gaining fresh and focused insight into former misconceptions. And an emerging field of study known as neuroeducation is becoming increasingly accessible and coherent in its mapping of the mind and its uniformly mysterious and marvelous functions.

This essay investigates major findings from the field of neuroeducation as they pertain to the remarkable and predictable neurophysiology at work in transformative learning experiences.

These include neuroscientific commonalities include the roles of (a) positive neurotransmitters, (b) brain-stem proteins, (c) long term potentiation, (d) the amygdala, (e) sensory stimuli, and (f) emotional valence that shape transformed perspectives and then reshape the uniform hieroglyphic of human perception.

The Uniform Hieroglyphic

“I guess it is a uniform hieroglyphic,” exclaims Walt Whitman regarding the consistent mysteries that unify the human experience (Song of Myself, Part 6). In his epic *Leaves Of Grass*, Whitman revels in the grand as well as the minute, the extraordinary as well as the mundane. And he suggests that the unifying commonality between all human experiences is what he describes as the uniform hieroglyphic of predictable mystery.

In contemporary terms uniform hieroglyphic connotes while humans comprise a wide variety of biological variation nature responds the same way to us all and like the root system of grass we are all interconnected. What remains is why we are indiscernibly connected and what happens to us as a result.

Transformative learning theory, too, is based in part on the determination of cause and effect relationships. It holds the learner accountable to make meaning of their experiences and hence learning. This practice is remarkable, yet sheds light on the often-cryptic experiences of perspective transformation—or gaining fresh and focused insight into former misconceptions. And an emerging field of study known as neuroeducation is becoming increasingly accessible and coherent in its mapping of the human mind and its uniformly mysterious and marvelous functions. It is moving us beyond didactics and pedagogy and provides us with tangible insights to make meaning of the brain’s link to learning processes.
This essay investigates a handful of major findings from the field of neuroeducation as they pertain to the remarkable yet increasingly predictable neurophysiology at work in transformative learning experiences. These include the roles of (a) brain-stem proteins, (b) salient stimuli impressions, (c) emotional valence, (d) amygdala-mindfulness, and (e) positive neurotransmitters that shape critical reflection and then reshape the uniform hieroglyphic of human perception.

**Learning and Transformation**

Current neuroscience research suggests our environments predictably yet mysteriously influence our perceptions—even to the extent that the world around us shapes and reshapes our mental maps. Our maps reflect the patterns of neurons that fire together and wire together in our brains. That’s to say that the outside world shapes the insides of our minds.

Beginning broadly, neuroeducation is the study of learning as it is supported and sustained by neurophysiology. Learning might be operationalized as a growth in awareness, understanding, and ability. Such interactions, according to education neuroscientist, are sparked by biochemical interactions within the active brain, and such interactions not only modify existing cognitive real estate but also expand and construct new brain cells—through processes known as neuroplasticity and neurogenesis.

Transformative learning, then, might be understood as the mindful restructuring of perspectives toward inclusiveness and accuracy (Mezirow, 2000 & Mezirow, 2009). This mindful restructuring is both purposeful and neuroplastic, as it reflects volition and produces physiological adaptation that sustains transformed perception, decision making, and behavior (cause, effect and feelings). Decades of research now appear to suggest some major commonalities in the uniform hieroglyphic of neurological functioning inside of the processes of mindfully restructuring perspectives.

**BDNF as Perspective Protein**

The first of the uniform hieroglyphics that likely contribute to perspective transformation is a protein known as brain-derived neurotropic factor (BDNF), which cranks up critical reasoning in the brain’s prefrontal cortex (Bucci, Davis, Vantieghem & Whalen, 2012; Begley, 2008; Doidge, 2007; Draganski, 2004; Fisher & Heikkinen, 2010; Medina, 2008; Ratey, 2008, Restak, 2007; Siegel, 2010; Sousa, 2010; Zull, 2011). BDNF is generated in the brain stem through physical activity, and the resulting prefrontal perspective protein is understood to peak in effectiveness within ninety minutes of modestly vigorous aerobic exercise.

While scientists have thoroughly documented the rational, executive thinking benefits of BDNF in journals such as *Nature* and newspapers such as the *New York Times*, the discussion of the role of BDNF in scaffolding perspective taking exercises and transformative learning experiences still remains relatively nascent.
As cognitive psychology becomes increasingly clear about the role of external experiences in shaping the form and function of neurons, scholars of transformative learning may do well to further investigate the role of BDNF in priming the pump of critical reflection. This lands squarely at the door of instrumental learning which is centered on learning by task-oriented problem solving and validating cause and effect relationships (Mezirow, 1991).

**Salient Sensory Stimuli**

A second major consideration in understanding and scaffolding perspective transformation is the process by which the brain receives and processes sensory stimuli. Evolutionarily, the human brain has learned to pay attention to novel stimuli, as these often indicate the presence of opportunities and threats. Researchers note that these novel stimuli engage comparatively more neurons in the occipital and parietal regions than do predicable stimuli, which become generally disregarded though a process of adaptive habituation (Begley, 2008; Doidge, 2007; Gardner, 2008; Jensen, 2008; Lehrer, 2007; Medina, 2008; Sylwester, 2010; Zull, 2002; Zull, 2011).

As transformative learning experiences are frequently triggered by encounters with novel and sensory stimuli, further consideration of the role of scaffolding salient sensory stimuli may assist those who teach and learn with transformative intentions. This follows the communicative learning aspect of transformative learning which engages how people convey their feelings, needs and desires (Mezirow, 1991).

**ECS to the PFC**

A third theme in the literature of neuroeducation that appears to be positively correlated with transformative learning experiences is the role of emotionally competent stimuli (ECS) in elaborative encoding and critical reflection in the prefrontal cortex (PFC).

Specifically, research indicates that sensory impressions that evoke emotionally-rich associations in the temporal regions of the brain are those that invite strong biochemical responses for elaborative encoding and long term recall in the hippocampus’s dentate gyrus (Immordino-Yang & Faeth, 2010; Medina, 2008; Posner, 2010; Sousa, 2010; Willis, 2010; Zull, 2011). The major implication seems to be that the objects of critical consideration are those that one finds most compelling to reflect upon, critique, and examine in light of new perspectives.

Engaging sensory stimuli have a gray matter partner in triggering transformations. This partner is the brain’s temporal region—which responds to engaging stimuli with positive biochemical responses in the hippocampus—where long term memory is elaboratively encoded for retrieval. Transformative learning experiences are likely encoded in this manner, with experience shaping neurons and neurons shaping perception, reflection, and meaning construction toward inclusivity, accuracy, and authenticity.

**Mindful of the Amygdala**

A tandem of brain structures known as the amygdalae also exert a major influence on
whether dissonant sensory stimuli are met with developmental or defensive responses. The amygdalae are a twin set of almond-shaped evolutionary protectors on residing on both sides of the brain.

Neuroscientists note that the amygdalae filter sensory perceptions for the presence of threat to survival. Stimuli that the amygdalae deem to threaten survival trigger an adrenaline-spiked physiological response that mobilizes fight, flight, and freeze. And while adrenaline is highly effective at energizing protective mechanisms, it is also widely understood as restricting critical thinking (Immordino-Yang & Faeth, 2010; Medina, 2008; Posner, 2010; Sousa, 2010; Willis, 2010; Zull, 2011).

In other words, threatening stimuli tend to erect developmental roadblocks rather than opening neuronal pathways for rational dialogue and critical reflection. While indeed each individual is unique in personal histories that fire and wire together, the universal role of the amygdalae twins in protecting the prefrontal cortex from disorientation will be a central consideration in how outside environments shape internal cognitive development.

**Positive Neurotransmitters**

Researchers are also finding that a trifecta of positive neurotransmitters are released when meaningful learning is taking place. Dopamine, norepinephrine, and serotonin are three of the learning brain’s intrinsic rewards that help construct and reinforce neuronal pathways between firing and wiring neurons (Begley, 2008; Doidge, 2007; Gardner, 2008; Jensen, 2008; Lehrer, 2007; Medina, 2008; Posner, 2010; Siegel, 2010; Sousa, 2006; Sylwester, 2010; Zull, 2002; Zull, 2011).

The learning brain releases these chemicals in association with what it deems to be positive and significant learning experiences. These resulting neuronal networks are more elaboratively encoded than biochemically neutral experiences. Because a hallmark trait of perspective transformation is its indelible effect on perception, the long-term-potentiating role of positive neurotransmitters may be a central consideration for scholar-practitioners who design and scaffold learning experiences with transformative aims.

**The Symbolic, Uniform Hieroglyphic**

In his epic *Leaves Of Grass*, Walt Whitman celebrated human experience through symbolic language. He spoke of the mystic contained within the mundane. He sang of the extraordinary effects of ordinary interactions. And so it seems that transformative learning theory and neuroeducation may be lenses into the larger discourse that Whitman described as uniform yet hieroglyphic.

As transformative learning theory and neuroeducation become increasingly accessible and coherent in their description of the human mind and its uniformly mysterious journey to maturity, this essay invites further inquiry and dialogue into the roles of (a) brain-stem proteins, (b) salient stimuli impressions, (c) emotional valence, (d) amygdala-mindfulness, and (e) positive
neurotransmitters that shape critical reflection and then reshape the uniform hieroglyphic of human perception.
References


