INTERIORITY AND EDUCATION: EXPLORING THE NEURO-PHENOMENOLOGY OF CONTEMPLATION AND ITS POTENTIAL ROLE IN LEARNING

supported by the Impact Foundation

Hart, T. (2008). Interiority and Education: Exploring the neurophenomenology of contemplation and its potential role in learning. *Journal of Transformative Education. 6*(4) 235-250.

Abstract

This article explores the concept of interiority as it relates to education and contemplation. Primarily, four general dimensions of consciousness that are related to learning are examined: presence, clarity, detachment, and resilience. The direct experience of these states and processes are described and tied to contemporary research on the neurophysiologic correlates of various contemplative practices. This neuro-phenomenological approach unpacks human consciousness as it relates to a pedagogy of presence and an epistemology of resonance. Ultimately this provides evidence and argument for considering the value of contemplation in education.

Interiority and education: Exploring the neuro-phenomenology of contemplation and its potential role in learning

Interiority

At a conference I attended recently, a presenter explained that he was involved with contemplative architecture. I think most of us in the audience were trying to imagine what this work was about. Did it mean building meditation halls or religious buildings? Were the construction workers hammering nails in unison with eyes closed? *"Use the force Luke..."*

When asked what contemplative architecture was he explained that it was to design a building with more space on the inside than there was on the outside. There was a pause as we all took this in.

For me, this image hinted at a key dimension of an education that is necessary for addressing the extraordinary peril and unprecedented possibilities of this age. The greater the information, technology, and demands from the world around us, the more essential is our interiority, that is, the inner capacities for discernment, imagination, virtue, balance, and presence.

Interiority in education is about developing spaciousness within us in order that we may meet and take in the world that is before us.

Knowledge by Presence

Interiority not only hints at the learner but also at the process of learning itself. The great texts of the wisdom traditions are often depicted as "living words." They are in some mysterious way described as alive on the page. This is why in all of the traditions there is invitation to reconsider the words again and again in order to see what light might be revealed this time around. It is as if the words are encrypted and compressed. To gain access to the mysteries and reveal the meaning we have to break the code.

The process of deep learning in secular education is no different. The biology text, the notes on the board, the "text" that is the person or situation in front of us, and the world as a whole are living words–awaiting expansion in order to be more fully understood. Their richness and dimensionality already exists here and now but must be decompressed and realized in some way.

I suggest that one secret to breaking the code lies in *knowledge by presence*, which involves looking not only at the outer data but also opening into our selves. Presence in this sense is eminently practical for learning and may be recognized by such qualities as: non-defensive openness, flexibility of thought, curiosity and questioning, a sense of wonder, suspension of disbelief, leading with appreciation over judgment, an emphasis on contact over categorization, accommodating rather than merely assimilating (in Piagetian terms), a willingness to really meet and therefore be changed by the object of inquiry whether a new idea or a new person.

The code is broken, the words come alive, and the world is opened only to the degree that there is a corresponding opening of consciousness within us. This is like a two-headed key opening a series of locks that lead simultaneously into our selves and into the data. This is, we might say, *reciprocal revelation.* In this sense we recognize that *what* we know is bound to *how* we know.

A Third Way of Knowing

Contemporary education is dominated by an approach to knowing that emphasizes both the rational, which involves calculation, explanation and logical analysis, and the sensory, characterized by observation and measurement. Together this knowing forms the rational-empirical approach that has set the standard for knowing across most disciplines. Rational-empiricism typically involves a style of knowing that emphasizes detachment and objectivity. However, if knowledge is further opened by presence and tied to interiority, other ways of knowing may be important for extending and deepening our epistemic reach.

Contemplation adds a third way of knowing–a missing link–that both complements and enhances the rational and sensory. The contemplative mind is opened and activated through a wide range of approaches–from pondering to poetry to meditation–that are designed to shift states of mind in order to cultivate such capacities as deepened awareness, concentration and insight. Historically, the contemplative has been used throughout the wisdom traditions as fundamental for developing interiority and uncovering the most essential knowledge, yet it is almost entirely absent from contemporary education.

What the contemplative offers education is not a different set of knowledge so much as an expanded approach to knowing, one that engenders:

• An *epistemology of presence* that moves past conditioned habits of mind to stay awake in the here and now.

• A *pedagogy of resonance* that shapes our graciousness and spaciousness toward meeting and receiving the world non-defensively.

• A *more intimate and integral empiricism* that includes in the consideration of the question a reflection on ourselves and on the question itself.

This century's demands seem to require an upgrade to our educational operating system. One in which the inner life balances our concerns for skills that serve the marketplace. In cultivating interiority, whether in secular or spiritual contexts, at elementary or university levels, contemplative knowing may help cultivate a learner with more space on the inside than a body betrays.

Church and State

Before going further I want to mention one concern that is sometimes seen as an obstacle to applying contemplation in public education: Is the separation of church and state threatened by using approaches in secular education akin to those developed in spiritual traditions? I suggest using contemplation in schooling is not a religious issue but a practical epistemic question. It is about *how* we know, not about *what* knowledge we are giving others. Inviting the contemplative develops the natural human capacity for knowing through silence, looking inward, pondering deeply, beholding, witnessing the contents of our consciousness and so forth. These approaches cultivate an inner technology of knowing and thereby a technology of learning and pedagogy without any imposition of religious doctrine whatsoever. If we knew that particular and readily available activities would increase concentration, learning, well being, social and emotional growth, and catalyze transformative learning, we would be cheating our students and our society to exclude it (see Hart, 2004).

Two Psychologies of Consciousness

One hundred years ago William James (1981), the reputed "father" of American psychology, recognized two complementary approaches to exploring human

consciousness. One looks directly at human experience through the tools of introspection and reflection unearthed by questions such as: "Where are you now? What are you thinking, feeling, sensing." The second approach is essentially neurobiology–the neuro-physiological correlates of experience. One hundred years later we have reached a point where these two streams of inquiry are coming together in an unprecedented fashion. Subtle subjective phenomenological descriptions along side data from brain measurement and imagining devices such as fMRI, CAT, SPECT, PET, EEG bridge these two domains. Terms such as "contemplative neuroscience" (e.g., Wallace, 2007) or neuro-phenomenology (Varela, 1996; Thompson, 2006) mark this "green zone" of mingling inner and outer technologies.

One note of clarification may be in order. This blended approach does not merely reduce experience to its neurological-biochemical substrates, as has been the pattern in a modernist biomedical paradigm. Rather than the brain operating in one-directional linear causality, current understanding recognizes that experience and brain/body activity are correlates of one another. Experience both effects and is affected by the brain/body.

By the way, as a sure indication that this integrative inquiry is on to something and simultaneously a sign that that the apocalypse is upon us, Marco Iacoboni (2006) and his group at the UCLA Ahmanson-Lovelace Brain Mapping Center, used functional magnetic resonance imaging (fMRI) to measure brain responses and self-reports in a group of subjects while they watched Super Bowl advertisements. This ushers in a brave new field of neuro-marketing.

Four Aspects

Applying a neuro-phenomenology lens, I would now like to explore four aspects of interiority and contemplation especially as they relate to learning: Presence, Clarity, Detachment, and Resilience. I am certain that we are really not ready to have any kind of definitive conversation of this evidence. There is simply not adequate data of this kind directly on education and learning. However, I think there is enough evidence to piece together some of the practical possibilities, logical connections, and relevant questions as they relate to learning and the inner life and in so doing to extend an exploration of what these inner technologies have to offer learning.

I also want to note that this work does not make any statements about the deep interior transformations that are often claims or goals of contemplative practice. This work is instead looking at the somewhat more tangible impact of various practices on the strata of experience, learning and knowing, brain changes, and behavior that are relevant for contemporary education.

1. Presence, Attention, Focus, Flow

If you have ever found yourself having just read several pages in a book only to pause and realize that you had no idea what you just read, you know the importance of focus and attention on learning. Through such experience we understand that in learning the *quantity* of time-on-task is subordinate to the *quality* of attention one brings to the task. If we are distracted, lost in our thoughts, or shut off in some way it is very difficult to absorb or learn well. An ability to focus, concentrate, and deploy attention is basic and essential to learning.

Nearly all contemplative practices train concentration–whether through such injunctions as repeating a mantra, focusing on love, watching the breath–in order to train the mind and quiet habitual internal chatter. The hundreds and even thousands of years of development of internal technologies in the wisdom traditions have something to offer contemporary learners. Without knowing another thing it would seem reasonable to explore technologies from contemplative practice if for no other reason than to help young people develop their capacities for attention and concentration. This may be especially valuable in a society where sounds bites, flashy images, streaming media, and living as perpetually accessible nodes on an information highway seems to be training minds for continuous partial attention (see Levy, 2006) rather than sustained and deep concentration.

Of course, such instrumental use of contemplative practice is not necessarily what the intention of a practice was designed for. Subtle inner changes that remain deeply personal and sometimes intangible are often described as a consequence of practice. Nonetheless, extending the application of such inner technology may prove reasonable and valuable for learning and living.

Attention, memory, learning and performance are largely state dependent–that is, the state of body, mind, and emotions are central to learning. Reading comprehension,

performance on the tennis court or while playing the flute depends not only on skill level but also on state of mind and body. For example, boredom, illness, distraction, and anxiety can directly effect functioning. At a less transitory level, attachment theory shows us that over the long haul, a secure attachment to primary care giver(s) provides the emotional and neurophysiologic base or state to be eager learners, without that security our body, brain and behavior tend toward a fearful, defensive retreat (e.g., Siegel, 1999).

One of the most well established effects of contemplation is a change in physiological state, which in turn cascades into shifts in affect and cognition. This state change, especially as it relates to the autonomic nervous system, has been well documented for more than 40 years. For example, if we ring a bell, close eyes, and focus on our breath or a sense of love we send a signal throughout the body-brain system that decreases blood pressure, lowers heart rate, reduces cortisol level (e.g., Murphy et al, 1997). Such an immediate shift can have powerful influence on the ability to focus or be present in the classroom by reducing anxiety and helping to quiet the habitual chatter of the mind. This shift in turn allows us to either lock on to material or consolidate freshly learned material thereby avoiding retroactive interference to memory (muddling up memory with the next material). For a child who goes into vapor lock at the sight of a math problem, *"One train leaves Kansas City at 3:00pm traveling eastbound at 70 miles per hour, a second train leaves Omaha at 1:30 traveling west at 45 miles per hour…"* shifts of state can dramatically change performance. In a program 20 years ago I worked with students who had math anxiety. What we discovered was that their difficulty had little to do with deficit abilities in math and nearly everything to do with the state of mind as they approached the problem. They had a very low frustration threshold toward math and would either leap into panic or drift into a kind of dissociative fog–"spacing out." What resolved their difficulty in a few sessions was teaching some basic contemplative skills and helping them find the right state to avoid "locking down" in an anxious reaction and then providing some very basic math instruction as needed. In this sense much of education may benefit from simultaneous training in both the right *skill* set and the right *mind* set.

In addition to this basic physiological response, some recent data suggest that the more an individual focuses attention, the more likely there is to be an increase in frontal

lobe activity in the brain. The frontal lobes are most often associated with higher cognitive function. Using SPECT scans Newberg et al (2001) found that meditation practitioners increased regional cerebral blood flow significantly during a practice involving visualization. In this form of Tibetan Buddhist meditation practitioners initially focus their attention on a visualized image and maintained that focus with increased intensity leading ideally to a sense of absorption into the image which in turn is associated with clarity of thought and loss of space and time perception. Similarly, Frith et al., (1991) and Pardo et al (1991) found similar increases in prefrontal cortical activity with attention-focused tasks. However, Lou et al (1999) did not demonstrate similar findings. Significantly, the difference was that participants in this study listened to a tape passively instead of intentionally focusing as was the case in the other studies. The more a person actively focuses attention, the more likely there is to be an increase in frontal lobe activity.

Maintaining focus leading to a sense of absorption and timelessness as mentioned above is frequently the natural state of a small child filled with wonder. Learning is joyful and deeply nourishing in such states. For learners at any age deeply pleasurable encounters involving focused concentration have come to be known as *flow* (Csikszentmihalyi, 1991). Whether working on a math problem, building a chair, or running rapids in a kayak, *flow* is characterized by high concentration on a particular activity, merging of action and awareness as we lose a sense of our self and along with it our usual sense of time. This immersion is deeply satisfying and the effort seems almost effortless–we and it are flowing. By deepening one's capacity for sustained concentration, concentrative contemplative practices may help engender flow states.

Additionally, the capacity for absorption, as in deep concentration and flow, is correlated with peak or mystical experiences (see e.g., Tellegen & Atkinson, 1974; Nelson, 1989). Attention reciprocally opens us and the world that deeply. William Blake (1976, p. 150) knew something about this

> To see a world in a grain of sand
> And a heaven in a wildflower
> Hold infinity in the palm of your hand
> And eternity in an hour.

2. Silence, Imagination, Creativity, Clarity

This is an age where the problems we face require creativity and imagination that extend beyond the information given. Creativity involves flexibility, originality, synthesis, insight, and divergence of thought. Imagination and creativity have a central place beside knowledge and logic at the table of education. In a 1929 interview published in the Philadelphia *Saturday Evening Post* Einstein, when asked about his own process of discovery, responded: "I'm enough of an artist to draw freely on my imagination, which I think is more important than knowledge. Knowledge is limited. Imagination encircles the world."

In addition to developing the ability to hold and deploy attention, some contemplative practices invite a kind of opening and receptivity that may result in a flow of new ideas, breakthrough insight or clarity. (Practices of silence may also lead to deep sense of peace and spaciousness without any form or content.)

Clarity and insight come unbidden, you cannot will them exactly. *"Okay, let me have a creative breakthrough now."* But they can be wooed and welcomed and this often involves a kind of interior emptying, a sense of surrender, openness and receptivity. Ancient Athenian philosopher Philo described his own inspirational breakthroughs in this way, "I have approached my work empty and suddenly become full, the ideas falling from a shower from above and being sown invisibly" (cited in Heschel, 1962, p. 333). Accounts like Philo's are quite common in the experience of creativity and inspiration (e.g., Hart, 1998, 2000). A variety of contemplative invocations from poetry, radical questioning, and certain meditations create both an opening and, as Suzuki (1970) called it, the "soft-mind" or as M. C. Richards (1962/1989, p. 63) named, "a soft spot to sprout it." (p. 63). Going to the university curriculum committee or to the School Board and saying we want to develop "soft mind" might be met with a little skepticism, but this open, flexible, divergent, receptive, "soft" consciousness so essential for discovery and creativity balances the "hard" critical intellect important for verification, deduction and analysis.

Whereas breakthrough and clarity may be an outcome, silence and stillness may hint at the process. Silence helps allow the small chattering mind to settle down and recede a bit, in turn opening awareness of more subtle currents of consciousness. There is no need to get into a metaphysical conundrum as to the source of these currents (e.g., God, our own mind, higher self, etc.) in order to recognize their functional value. Especially as it relates to education, the value

lies in the quality of the material or insight as well as the more enduring shifts in being rather than in an attribution of source. And again, sometimes there is silence with no content whatsoever. In some instances a subtle transformation of consciousness is claimed to take place out of immediate awareness and without any identifiable form.

In Persian poetry the poet often refers to himself or herself by name at the end of poem as a sort of signature. In five hundred odes, Rumi, concludes with the word *khamush*, silence. In silence, in emptiness, in stillness, we open to some deep place and become its conduit. Rumi (1995) said it this way:

There is a way between voice and presence where information flows.

In disciplined silence it opens.

With wandering talk it closes." (p. 109)

The "disciplined silence" requires, as Rollo May (1975) said, "hold[ing]. . . [oneself] alive to hear what being may speak. [This] requires a nimbleness, a fine-honed sensitivity in order to let one's self be the vehicle of whatever vision may emerge" (p. 91). Gowan (1977) makes the point this way, "When Michelangelo did the Sistine Chapel he painted both the major and the minor prophets. They can be told apart because, though there are cherubim at the ears of all, only the major prophets are *listening*" (p. 250).

At least two different kinds of neuroscience data may correspond to experiences of silence, breakthrough and clarity. The first is a change in EEG alpha and theta rhythms. Increased alpha activity (8-12 hertz) is associated with deep relaxed alertness–silence and stillness–that also seems to be a gateway into theta (4-7 hertz) states, which have been associated with the experience of creative breakthrough (e.g., Green and Green, 1986). A variety of studies (e.g., Banquet, 1972; Benson et al, 1990; Hirai, 1974; Shapiro, 1980) found increases in alpha and theta activity over the frontal regions of the brain during meditation. These studies mainly investigated different forms of voluntary concentrative meditation on an "object" (e.g., mantra or breath).

Along with descriptions of breakthrough, sometimes we may describe moments as characterized by extraordinary clarity when it feels like our whole brain seems to be working. Perhaps clarity of this sort is related to neural synchrony. In addition to alpha and theta activity, large-scale brain coordination appears in recent studies on gamma wave (25-42+ hertz) synchrony. Long-distance (throughout the brain) synchrony is thought to reflect large-scale

neurocoordination. (e.g., Singer, 1999; Varela et al, 2001) and occurs when two or more distant electrodes oscillate with a precise phase relationship that remains constant over time. Lutz et al (2004) found that large-scale brain coordination increases during mental practice (in this case loving kindness and compassion meditation in which participants were asked to generate feelings of love and compassion toward all sentient beings without focusing on anyone in particular) and that the size of synchrony patterns increased more for long-term practitioners (8 long-term Buddhist practitioners) than for the controls (10 student volunteers who were trained over a week) when participants shifted from neutral to meditation states. The difference between the groups grows greater during meditation and continues following the meditation. Further, the two groups (long-term meditators and the control) had different electrophysiological baseline signatures, which are characterized by a higher ratio of gamma-band oscillatory rhythm to slow oscillatory rhythm for the long-term practitioners. In other words, it appears that the baseline or "resting" state of the brain may be altered by long-term contemplative practice resulting in a generalization of state benefit to our general presence. Lutz et al's study suggests that cognitive (i.e. clarity) and affective processes that gamma wave activity may reflect are flexible skills that can be trained.

While we do not know the functionally consequences of sustained gamma activity and these studies are very preliminary, it may indeed relate to a state of clarity and "fine-honed sensitivity."

3. Detachment, Witnessing, Metacognition.

William James made a distinction between the "I" and the "me." The "me" represents the contents of our consciousness–the thoughts, feelings, and sensations that rise and fall throughout our waking life. The "I" is that part of us that can watch or witness those contents. What are you aware of right now? What thoughts, feelings, and sensations do you notice? If you are able to notice then some aspect of you was doing the noticing–what James called the "I" and others have referred to as the witness or observer.

A practice of mindfully watching what arises in the stream of consciousness–thoughts, feelings, sensations–without either pushing them away or clinging to them, develops a capacity for detachment (e.g., Eckhart, 1958). This detachment is most often described not as a distant objectivism but instead as a non-defensive attitude of interest and curiosity. For example, rather than just feeling angry, such witnessing allows us to step back and notice–"I see that this is really

upsetting me" and perhaps inquiring about it while in the midst of it: "I wonder what this anger is about?" This not only develops the potential for emotional regulation and impulse control, but also develops interior "muscles" of reflection leading to metacognition. Emerson hints at this developmental arc: "Our thoughts first possess us. Later, if we have good heads, we come to possess them" (Sealts, 1992, p. 257).

In this witnessing or watching what occurs is "a mindful reflection that includes in the reflection on a question the asker of the question and the process of asking itself" (Varela, Thompson, & Rosch, 1993, p. 30). This process "begin[s] to sense and interrupt automatic patterns of conditioned thinking, sensation and behavior" (p. 122) opening one to see in fresh ways. Such openness, curiosity, and flexibility toward what we are observing are characteristic of great learners and deep learning. In addition, as we simply and honestly observe and tolerate our own reactions, we may also gain a tolerance for others, central to understanding multiple points of view, a characteristic of higher order cognitive functioning and implicated in empathic understanding. Self-observation and reflection help to expose and deconstruct positions of role, belief, culture, and so forth in order to see more deeply or from multiple perspectives. This allows students the conceptual flexibility to see beyond the information given and beyond their own presuppositions.

Contemplative practices are traditionally designed not only for short-term state shifts but also as a way to cultivate more generalized long-term traits, such as compassion or detachment that, if successful, should be reflected in neurobiological data. Aftanas and Golosheykin (2005) tested twenty-five Sanyga yoga meditators, whose practice involves "thoughtless awareness" or "mental silence" (p. 895). They did demonstrate increased alpha and theta activity during meditation but there was also another effect while not meditating. The two groups were shown 4 brief video clips; three clips where "emotionally neutral" and one "emotionally negative" (an except from Michael Haneke's film Funny Games in which two young people are abusing a family). In the study EEG data reflected lower "tonic arousal" and greater proneness to sustain "internal locus of attention." Essentially the data suggested that the meditation group did not get carried away in a reactive state so easily, did not lose their "center" and were able to maintain a degree of openness and witnessing detachment. Impulse control problems, distractibility, road rage, violence on the playground, inability to sustain attention, frustration tolerance,

and distractibility are all affected by this capacity. In this sense such practice seems to provide, as T. S. Elliot (1971) said, a kind of "stillpoint in a turning world."

Travis et al (2002) studied the EEG patterns of long-term Transcendental Meditators who report transcendental experiences not only during formal meditation but also co-existing with waking and sleeping states. One participant describes the integrated state in this way, "The flurry of waking activity comes and goes; the inertia of sleep comes and goes. Yet, throughout these changing values of waking and sleeping there is a silent, unbounded continuum of awareness that is me; I am never lost to myself" (p. 295). Perhaps this is also a way of describing a particular type of centeredness or detached steadiness. EEG data did indeed record functional differences in those individuals who describe this merging of experience (Travis, et al, 2002).

Recent studies not only imply that contemplative practice impacts brain function but also may change brain structure itself, specifically cerebral cortical thickness, the outer layer of the brain (Lazar et al, 2006). In this study the experimental group consisted of 20 people with extensive training (an average of nine years, forty five minutes daily, six days a week) in Buddhist insight meditation; the control group consisted of fifteen non-meditators. Structural MRI of the two groups showed that the meditators had increased thickness in the cerebral cortex in a region called the insula, central to integrating thoughts and emotions. Most of the thickening was in the right hemisphere in the prefrontal cortex, which appears related to sustaining attention and regulating memory. Those regions often thin with age so one idea is that mediation may slow age related tissue loss. Three of the twenty meditators also practiced yoga and had even greater cortical thickness. (By the way, this last bit of information raises questions about the potential role of movement, posture and the body in the process of learning. We will leave this for another day.)

While long-term meditation effects on neuroplasticity are interesting, we cannot yet be certain that individuals inclined to 10,000 hours of meditation were not thick, cortically speaking, to begin with. While it has been recognized that the brain changes in responses to activity (Musicians brains change after years of practice; individuals who speak two languages have greater density in those parts of the brain primarily responsible for language; London cab drivers are reported to have greater activation in brain areas

related to spatial awareness.), this study suggests that the brain changes in response to the purely *internal* mental activity of contemplation, which, in turn, may impact cognitive and affective function.

4. Resilience, Emotional Balance, Well Being

Education has become increasingly involved in teaching for character, health, and civility, reflecting contemporary societal needs. Young people are growing into a world of unthinkable violence in schools, where stress is implicated in the top six causes of death (e.g., Stress, 2007), where the third leading cause of death for 10-14 year olds is suicide and the second and third leading causes of death for 15-24 years olds are homicide and suicide respectively (National, 2007), where millions of children are on antidepressants (Shogren, 2004), where constant electronic stimulation gives access not only to dizzying amounts of information but also to sex, violence and sophisticated advertising.

The greater the complexity and demands–the external stressors–the greater need for psychological and emotional balance and resilience. In a state of chronic stimulation or low-grade anxiety it is difficult to concentrate, step back and watch ourselves, be still and silent, and maintain sensitivity toward one another. In other words, our emotional state is significant not only for our well being but also for our capacity to learn.

Contemplative practices appear to help the individual return from and modulate a state of arousal and therefore may be valuable for balance and resilience. During stress what has come to be referred to as the HPA axis (hypothalmus, pituitary, adrenal cortex) coordinates autonomic nervous system response that gets us ready for fight or flight in part by increasing levels of cortisol. But in an age of constant stimulation designed to grab our attention, shock or arouse us, not to mention the accelerated pace of the day, we may not return to an optimal baseline state. The hyper arousal of the HPA axis and elevated levels of cortisol have been related to obesity, memory deficit (Raber, 1998) even the neurobiology of suicide (Lopez et al, 1997). Chronic stress or corticosterone treatment induces pathological alterations, such as dendritic atrophy in hippocampal neurons (where the highest concentration of glucocortical receptors exist), which are paralleled by cognitive deficits. The good news is that contemplation reduces the level of

cortisol during non-stressful events, increases response during stress and quickens the return to baseline levels (e.g., Maclean, et al, 1997).

In addition to these biochemical changes, another line of affective neuroscience research has uncovered a difference in the activity of the prefrontal cortex that may have something to tell us about well being and resilience. A difference in relative activation of the left versus the right prefrontal cortex reflects differences in emotional responsiveness. Greater relative activity on the left side seems to correspond to "positive" emotional states (joy, empathy, caring, etc.) as opposed to anxiety, depression, etc. and greater emotional resilience. High relative activation in the left versus the right prefrontal cortex marks either a fleeting positive mood or a positive affective style, which is the quality of mood that endures (Davidson, 2000; 2004).

Davidson's research with Buddhist monks reveal that their ratio of left to right activation was greater than any of the non-meditating participants previously tested. When the monks and the non-trained subjects were asked to meditate on compassion the monks showed a greater shift toward the left-prefrontal cortex than control subjects. Focus on virtuous or positive mental states, such as compassion, empathy, joy as opposed to anxiety and depression, may engender a more resilient affective style including a greater modulation of and faster recovery from stressful events.

It should be clarified that experiencing a variety of emotions is not intrinsically maladaptive neither is just promoting positive feelings entirely adaptive. For just one example, the value of emotional expression and processing difficult emotional material in enhancing immune system response as well as overall health is now supported in a variety of studies (e.g., Cole, et al, 1996; Dreher, 2003; Esterling, et al, 1990; Pennebaker, 1989).

Akin to Davidson's findings, Tomarken et al (1992) found that baseline measures of asymmetric prefrontal activation predicted reports of well being among individuals in their late 50s. Those individuals with greater baseline left prefrontal activation responded more positively to positive film clips and those with greater right prefrontal activation responded more negatively to negative clips. So when a negative video clip is played, those negative emotions fade more quickly in those with greater left to right ratio.

Essentially this describes relative vulnerability to emotional elicitors. (Urry et al, 2004; Wheeler et al, 1993; Tomarken et al, 1990)

But what may be even more immediately significant for learning is a randomized controlled study in which participants were trained in an 8-week training program in their work place centered on mindfulness meditation (Davidson et al, 2003). Two measures were employed: 1) brain electrical activity was measured before, immediately after and 4 months following the training program. 2) An influenza vaccine was given to both the experimental group and the control.

Those trained in the eight-week program showed a greater relative activation of left pre-frontal cortex (associated with "positive" affect). Additionally, there was a significantly increased immune response (antibody titers) to the vaccine among the meditation group compared with the control group. The magnitude of the increase in immune response was predicted by the magnitude in the increase in left side activation.

To be clear, the training program involved a variety of activities along with the mindfulness practice and therefore we cannot say with certainty that the practice alone was the key factor in the change.

However, in combination, these studies point to the potential value of contemplation in engendering emotional resilience, which in turn may impact one's capacity to learn.

Conclusion

It is no news that we live at a time when the world seems to be spinning faster. Information abounds like never before. Both the imminent threats and the constructive possibilities at the horizon are almost unfathomable. If we are to prepare students and ourselves for this accelerated and challenging world, and aspire to more than merely trying to keep up or catch up, something more than a stockpile of information and skills sets is required. This article suggests that the greater the complexity and demands of the outer world, the more essential are qualities of interiority.

This preliminary review suggests that capacities for presence and attention, breakthrough and clarity, detachment and metacognition, and emotional resilience and balance are significant components of interiority that may be valuable for enhancing the process of learning and living. Further, these dimensions have neurological substrates

that are affected by a wide-range of contemplative practices. Neuro-phenomenological data demonstrate that significant changes are indeed occurring in the mind (experience) and the brain as a result of contemplative practice. The effects on the neurophysiological changes range from immediate state shifts to long-term trait patterns to changes in brain structure.

Developing interiority may be most valuable not simply as an adjunct to knowledge acquisition but as central and essential to the process of deep and life-long learning. Learning more and more deeply is tied to the way and to the degree that we meet information. Contemplation as a way of knowing complements and enhances rational and sensory epistemic modes and may enrich capacities to meet oneself, one another, and tends to approach information non-defensively, pregnant with depth.

So can the architecture of education engender more spaciousness and graciousness to welcome in the world? When educational practice recognizes that internal and external are bound to one another and also transformed by one another in a kind of reciprocal revelation then education moves toward becoming a wisdom tradition itself.

References

Aftanas, L., Golosheykin, S. (2005). Impact of regular meditation practice on EEG activity at rest and during evoked negative emotions. *International Journal of Neuroscience, 115,* 893-909.

Banquet, J.P. (1972). EEG and Meditation. *Electroencephalography and Clinical Neurophysiology, 33,* 454.

Benson, H., Malhorta, M.S., Goldman, R.F., Jacobs, G.D., & Hopkins, P.J. (1990). Three case reports of the metabolic and electroencephalographic changes during advanced Buddhist meditation techniques. *Behavioral Medicine, 16* (2): 90-95.

Blake, W. (1976). "Auguries of Innocence," in *The Portable Blake*, ed. A. Kazin (1804; reprint), New York: Penguin Books.

Cole, S.W., Kemeny, M. E., Taylor, S. E., Visscher, B. R. Elevated physical health risk among gay men who conceal their homosexual identity. *Health Psychology 15*, 243-251.

Csikszentmihalyi, M. (1991). *Flow: The Psychology of Optimal Experience*. New York: Harper Perennial.

Davidson, R. J. (2000). Affective style, psychopathology, resilience: Brain Mechanism and Plasticity. *American Psychologist.* November. 1196-1214.

Davidson, R. J., Kabat-Zinn, J., Schumacher, J., Rosenkranz, M., Muller, D., Santorelli, S. F., Urbanowski, F., Harrington, A., Bonus, K., Sheridan, J. F. (2003). Alternations in brain and immune function produced by mindfulness meditation. *Psychosomatic Medicine, 65,* 564-570.

Davidson, R. J. (2004). Well-being and affective style: neural substrates and bio-behavioral correlates. *Philosophical Transactions of the Royal Society (London), 359,* 1395-411.

Dreher, H. (2003). *Mind-Body unity: A new vision for mind-body science and medicine.* Baltimore: The Johns Hopkins University Press.

Eckhart, M. (1958). *Meister Eckhart: Selected treatises and sermons* (J. M. Clark & J. V. Skinner, Trans.). London: Faber & Faber.

Eliot, T. S. (1971). *Four Quartets.* New York: Harcourt, Brace, and World.

Esterling, B. A., Abtoni, M. H. , Kumar, M., Schneirderman, N. (1990). Emotional repression, stress disclosure responses, and Epstein-Barr viral capsid antigen titers. *Psychosomatic Medicine 52* 397-410.

Frith, C. D., Friston, K., Liddle, P. F., Frackowiak, R. P. J. (1991). Willed action and the prefrontal cortex in man: a study with PET. *Proceedings of the Royal Society of London, 244,* 241-246.

Gowan, J. C. (1977). Creative inspiration in composers. *The Journal of Creative Behavior, 11*(4), 249-255.

Green, E. E. & Green, A. M. (1986). Biofeedback and states of consciousness**.** In B. B. Wolman & M. Ullman (Eds.), *Handbook of States of Consciousness*, (pp. 553-589). New York: Van Nostrand Reinhold Company.

Hart, T. (1998). Inspiration: An exploration of the experience and its meaning. *Journal of Humanistic Psychology, 38* (1), 7-35.

Hart, T. (2000). Inspiration as knowing. in T. Hart, K. Puhakka, P. Nelson, Eds. *Transpersonal Knowing: Exploring the horizon of consciousness*. State University of New York Press.

Hart, T. (2004). Opening the contemplative mind in the classroom. *Journal of Transformative Education 2* (1) 28-46.

Heschel, A. J. (1962). *The Prophets.* New York: Harper and Row.

Hirai, T. (1974). *The Psychophysiology of Zen*. Tokyo: Igaku Shoin.

Iacoboni, M. (2006, February 6). Who Really Won the Superbowl? The Story of an Instant-Science Experiment. *Edge: The Third Culture.* Retrieved January 5, 2006, from http://www.edge.org/3rd_culture/iacoboni06/iacoboni06_index.html

James, W. (1981). *The Principles of Psychology*. Cambridge: Harvard University Press.

Lazar S.W, Kerr C., Wasserman R.H., Gray J.R., Greve D., Treadway M.T, McGarvey M., Quinn B.T., Dusek J.A., Benson H., Rauch S.L., Moore C.I., Fischl B., (2005). Meditation experience is associated with increased cortical thickness. *NeuroReport, 16*, 1893-1897.

Levy, S. (2006). (Some) attention must be paid! *Newsweek*, March 27, 16.

Lopez, J. F., Vazquez, D. M., Chalmers, D. T., Watson, S. J. (1997). Regulation of 5-HT receptors and the hypothalamic-pituitary-adrenal axis. Implications for the neurobiology of suicide. *Academy of Science, 29*(836), 106-34.

Lou, H. C., Kjaer, T. W., Friberg, L., Wildschiodtz, G. Holm, S., Nowak, M. (1999). A ^{15}O-H_2O PET study of meditation and the resting state of normal consciousness. *Human Brain Mapping, 7*, 98-105.

Lutz, A., Greischar, L. L., Rawlings, N. B., Ricard, M., Davidson, R. J. (2004). Long-term meditators self-induce high-amplitude gamma synchrony during mental practice. *Proceedings from the National Academy of Science, 101*(46), 16369-16373.

MacLean, C., Walton, K., Wenneberg, S., Levitsky, D., Mandarino, J., Waziri, R., Hillis, S.L. and Schneider, R.H. (1997). Effects of the Transcendental Meditation program on adaptive mechanisms: changes in hormone levels and responses to stress after 4 months of practice. *Psychoneuroendocrinology, 22*(4), 277-295.

May, R. (1975). *The Courage to Create.* New York: Bantam Books.

Murphy, M., Donovan, S., & Taylor, E. (1997). *The physical and psychological effects of meditation: A review of contemporary research 1991-1996* (2nd ed.). Petaluma, CA: Institute of Noetic Sciences.

National Center for Injury Prevention and Control: 10 Leading Causes of Death, United States. (2004). Retrieved January 16, 2007, from http://webappa.cdc.gov/cgi-bin/broker.exe

Nelson, P. L. (1989). Personality factors in the frequency of reported spontaneous præternatural experiences. *The Journal of Transpersonal Psychology, 21*, 193-209.

Newberg, A, Alavi, A. Baime, M., Pourdehnad, M., Santanna, J., d'Aquili, E. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: a preliminary SPECT study. *Psychiatry Research: Neuroimaging, 106,* 113-122.

Pardo, J. V., Fox, P. T., Rachle, M. E., (1991). Localization of a human system for sustained attention by positron emission tomography. *Nature, 349*, 61-64.

Pennebaker, J. W. (1989). Confession, inhibition, and disease. *Advances in Experimental Social Psychology. 22* 239-245.

Richards, M. C. (1962/1989). *Centering in pottery, poetry, and the person.* Hanover, NH: Wesleyan University Press.

Raber, J. (1998). Detrimental effects of chronic hypothalamic-pituitary-adrenal axis activation. From obesity to memory deficits. *Molecular Neurobiology, 18*(1), 1-22.

Rumi, J. (1995). *The essential Rumi* (Barks, C. with Moyne, A., Arberry, J. & Nicholson, R., Trans.). San Francisco: Harper San Francisco,

Sealts, M. M. (1992). *Emerson on the scholar.* Columbia, MO: University of Missouri Press.

Shapiro, D. H. (1980*). Meditation: Self-regulation strategy and altered state of consciousness*. New York: Aldine.

Siegel, D. J. (1999). *The Developing Mind: How Relationships and the Brain Interact to Shape Who We Are.* New York: Guilford Press.

Suzuki, S. (1970). *Zen mind, beginner's mind: Informal talks on Zen meditation and practice.* New York: Weatherhill.

Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences ("Absorption"), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology, 83,* 268 - 277.

Thompson, E. (2006). Neurophenomenology and Francisco Varela. In A. Harrrington and A. Zajonc (Eds.). *The Dalai Lama at MIT.* (pp. 19-24). Cambridge: Harvard University Press.

Tomarken, A. J., Davidson, R. J., Henriques, J. B. (1990). Resting frontal activation asymmetry predicts emotional reactivity to film clips. *Journal of Personality and Social Psychology, 59,* 791-801.

Tomarken, A. J., Davidson, R. J., Wheeler, R. E., Doss, R. C. (1992). Individual difference in anterior brain asymmetry and fundamental dimension of emotions. *Journal of Personality and social Psychology, 62,* 676-687.

Travis, F. T., Tecce, J., Arenander, A., & Wallace, R. K. (2002). Patterns of EEG coherence, power, and contingent negative variation characterize the integration of transcendental and waking states. *Biological Psychology, 61,* 293-319.

Urry, H. L., Nitschke, J. B., Dolski, I., Jackson, D. C., Dalton, K. M., Mueller, C. J., Rosenkranz, M. A., Ryff, C. D., Singer, B. H., Davidson, R. J. (2004). Making a life worth living: Neural correlates of well-being. *Psychological Science, 15,* 367-372.

Varella, F. J. (1996). Neurophenomenology: A methodological remedy for the hard problem. *Journal of Consciousness Studies, 3,* 330-350.

Varela, F., Thomson, E., & Rosch, E. (1993). *The embodied mind: Cognitive science and human experience.* Cambridge, MA: M.I.T. Press.

Wallace, B. A. (2007). *Contemplative Science: Where Buddhism and Neuroscience Converge.* New York: Columbia University Press.

Wheeler, R. E., Davidson, R. J., Tomarken, A. J. (1993). Frontal brain asymmetry and emotional reactivity: A biological substrate of affective style. *Psychophysiology, 30,* 82-89.