**Reviewing Mindfulness of Breathing Meditation Practice**

A fundamental practice within all of the Buddhist traditions involves cultivating a persistent conscious contemplation of the sensations associated with the normal routine of inhalation and exhalation. This review will focus on the traditional procedural processes of the practice, along with what contemporary research reveals about how the practice changes the structures of the brain in beneficial ways.

**Reviewing The Traditional Teachings**

There are two primary Buddhist discourses that refer to mindfulness of breathing meditation: the Satipatthana Sutta (sah-tee-pah-tah-nah soo-tah) and the Anapanasati Sutta (ah=nah-pah-nah-sah-tee soo-tah). Both discourses begin by describing the practice in similar ways. Here is a passage from the Satipatthana Sutta, from page 4 of “Satipatthana—The Direct Path to Realization” by Analayo:

“And how, monks, does he in regard to the body abide contemplating the body? Here, gone to the forest, or to the root of a tree, or to an empty hut, he sits down; having folded his legs crosswise, set his body erect, and established mindfulness in front of him, mindful he breathes in, mindful he breathes out.

“Breathing in long, he knows ‘I breathe in long,’ breathing out long, he knows ‘I breathe out long.’ Breathing in short, he knows ‘I breathe in short,’ breathing out short, he knows ‘I breathe out short.’ He trains thus: ‘I shall

breathe in experiencing the whole body,’ he trains thus: ‘I shall breathe out experiencing the whole body.’ He trains thus: ‘I shall breathe in calming the bodily formation,’ he trains thus: ‘I shall breathe out calming the bodily formation.’

“Just as a skilled turner or his apprentice, when making a long turn, knows ‘I make a long turn,’ or when making a short turn knows ‘I make a short turn’ so too, breathing in long, he knows ‘I breathe in long,’… (continue

as above).

“In this way, in regard to the body he abides contemplating the body internally, or he abides contemplating the body externally, or he abides contemplating the body both internally and externally. Or, he abides contemplating

the nature of arising in the body, or he abides contemplating the nature of passing away in the body, or he abides contemplating the nature of both arising and passing away in the body. Or, mindfulness that ‘there is a body’ is established in him to the extent necessary for bare knowledge and continuous mindfulness. And he abides independent, not clinging to anything in the world.

“That is how in regard to the body he abides contemplating the body.

In practice, contemporary teachers suggest focusing attention persistently most often in two areas—the area around the rim of the nostrils and the upper lip, or the expansion and contraction of the abdomen. I asked Bhante Gunaratana the anticipated results of either area, and he suggested that focusing on the first area produces a more precise and refined level of concentration, suitable for cultivating jhana, while the second area provides a large area of focus, for cultivating a more generalized insight, without jhana attainment.

The terminology of the sutta(s) recommends noticing the transitory nature of breath awareness, either long or short in duration, with persistently active curiosity. This promotes a sustained awareness of the neutrality of changing breath sensations, the benefits of which will be elaborated further on in these notes. The sustained, neutral feeling tone is extended to include noticing any tension elsewhere in the body and relaxing that tension on the out-breath—experiencing the whole body and calming the whole body.

This insightful process then is related to the internal sensations of the body and the external sensations associated with the environment—“contemplating the body externally”. This provides a holistic investigation of impermanence—“both arising and passing away in the body.” The following phrase “mindfulness that ‘there is a body’ is established in him to the extent necessary for bare knowledge” brings attention to the impersonal nature of embodied sensational experience, decreasing attachment to belief in an enduring self.

With breath awareness established, the Satipatthana process cultivates increasing profound insights into contemplations of feelings, qualities of consciousness, and then the conditioning factors of consciousness that, when deeply understood, lead to Awakening.

Regarding the Anapanasati process, the progression of contemplations develops through 16 steps—the Four Tetrads, with first reflecting mindfulness of the body, the second regarding feelings, the third contemplating consciousness, and the fourth tetrad investigating the conditioned nature of subjective experience. The fourth categories in both discourses emphasize contemplation of the Seven Awakening Factors, with the intention of unifying their functions to the highest level of insightful comprehension.

For further studies of these discourses, I recommend three of Analayo’s books: “Satipatthana—The Direct Path to Realization”, “Satipatthana Meditation—A Practice Guide”, and “Mindfulness of Breathing—A Practice Guide and Translations”. They combine a comprehensive scholarly review with the author’s own contemplative insights; they are not easy reading, but if you really want to understand these two discourses, the books are worth the effort. The first book can be downloaded as a .pdf through this URL: <https://discourse.suttacentral.net/t/mn10-satipa-hana-the-direct-path-to-realization-by-bhikkhu-analayo/559> The mindfulness of breathing book can only be purchased currently.

**Reviewing Supportive Contemporary Research**

The following notes reflect a talk presented previously that have relevance to this review:

There are key areas of the brain that process emotionally charged events and impose meaning on the raw sensory data of life, such as seeing, hearing, etc. These areas are dynamically functioning, constantly transforming energy into information. Through the process of long-term potentiation (LTP), involving clusters of neurons firing synchronously, that is, at the same frequency (times per second) and amplitude (strength of the neural firing), patterns are established that are enduring and which affect areas throughout the brain and body. As the various neural networks are activated, energy is channeled to and through them (glucose and oxygen, mostly) and the networks become more strongly interconnected and easier to activate.

These neural pathways have been extensively researched and which revealed areas of the brain that are associated with various emotional, cognitive, and behavioral functions. There are a multiplicity of these pathways in the brain; here are the ones that are most important for the process of Awakening:

**THE AMYGDALA**: The amygdala system includes two nodes—one in each hemisphere. Research indicates that the amygdala in the right hemisphere predominantly processes fear and sadness, while the left hemisphere amygdala processes both fear, sadness, and happiness, and is more directly associated with motivational impulses. The amygdala sends affective alerting signals to other areas of the brain, inducing stress, which can either be pleasant (eustress) or unpleasant (distress). When the amygdala is overstimulated through distress, the body generates cortisol, which is important for effectively responding to threatening situations, but becomes toxic when chronically active in the brain and body. Additionally, the amygdala becomes “predisposed” to alarm, because of the close proximity of the hippocampus and the complex, mutually reinforcing interactions between the various neural pathways.

**THE HIPPOCAMPUS**: The hippocampal system also is found in the right and left hemispheres. The function of the right hippocampus seems to be strongly coordinated with the right amygdala and relates the emotional impulse of stimulation to prior emotionally potentiated episodic memory. The left hippocampus is also associated with the right amygdala, but its function is more related to associating episodic memory and language. Perhaps this is why, in psychotherapy, there is a benefit to being able to use words to describe emotional experience; in this way, the synchronistic linking process is more accessible to awareness. In meditative practices, the meaningfulness of a repeated mantra reflects this function.

**THE NUCLEUS ACCUMBENS**: These nuclei are also bilateral, with one in each hemisphere. In both hemispheres, the function seems to be oriented towards reward, that is, motivation for action to experience pleasure or to avoid pain. The nucleus accumbens has been researched extensively, revealing that the system, which is strongly linked with the amygdala and hippocampus neural projections, becomes “stuck in the on position”. The hyper aroused system can be activated along with any other neural pathways that nurture distraction or pleasurable feelings. Of course, this could manifest as addictive behavior; current research also supports how this is associated with what are called “process addictions”, that is, repetitive, compulsive interactions with processes not involved with intoxicating substances. Examples would include extensive, detrimental access to internet media, tv “binge watching”, overspending with credit cards, sexual hyperactivity, and binge eating.

The above areas are found in what is called the limbic area of the brain and are mostly involved in how the mind perceives “Friend or foe? Food or poison?” regarding environmental circumstances. We could say that the amygdala and nucleus accumbens are most associated with the Buddhist concept of *craving*, while the hippocampus, which has extensive connections to the areas of the brain where associational memories are stored, represents Buddhist *clinging*.

Mindful awareness of these areas and the ability to regulate responses to their activities involves other locations in the brain; contemporary research suggests that these locations are beneficially affected by mindfulness of breathing and lovingkindness meditative training. Here are some of the areas most often referred to in the research:

**ANTERIOR CINGULATE CORTEX (ACC)**: This area represents the “seam” between the left and right lobes of the cerebral cortex, particularly the frontal area, beginning at the top of the forehead and extending toward the rear. The anterior cingulate is associated with conscious awareness and “error detection and conflict monitoring”. This suggests that the function of the ACC is involved with mindfulness and vipassana, that is, the ability to investigate what is emerging in consciousness and discern whether the emerging self-state organization is wholesome or unwholesome. The ACC is strongly connected to areas in the brain associated with the limbic system, including the amygdala, hippocampus, insular cortex and nucleus accumbens. *The function of the ACC has been found to be enhanced among trained meditators*.

**INSULAR CORTEX**: This area of the brain is the interior lining of the temporal lobe of the cerebral cortex, above the ears, and is next to the limbic system, close to and strongly connected to the amygdala and hippocampus. There is a similarity between some cellular structures in the insula and the ACC, and both areas seem to be associated with conscious awareness; the insular areas are associated with interoceptive awareness, that is, awareness of internal body processes. The insula also associates internal bodily awareness (mindfulness of the body, including breath awareness) with higher cognitive functions. Among these higher cognitive functions are emotional awareness, interpersonal awareness (Through the function of mirror neurons, which are associated with mimicry and empathy) and experiences of spiritual communion. The strength of connections and enhanced functioning of this area among well-trained mindfulness meditators is observed through fMRI (functional Magnetic Resonance Imaging) research. *The interactions between the Insular Cortex, the PFC and the ACC represents what is called the Salience Network (SN), which functions to determine the relative importance of neural processes that integrate one’s consciousness and behaviors*. The word *salience* refers to *the importance of a developing stimulus*.

**PREFRONTAL CORTEX (PFC)**: This is one of the most interconnected areas of the brain. It can be subdivided into the orbitofrontal cortex (OFC), located just above the eye sockets, the ventromedial cortex (vmPFC), just behind the OFC, and other neural locations in the front of the brain. *Research suggests that the functions of these areas is to monitor and regulate emotional and cognitive processes*. It is well known that when a person is chronically stressed or depressed, the right prefrontal cortex has a stronger “signal strength” and is therefore initiates dysfunctional responses to stimuli. Conversely, when a person is unstressed and happy, the left prefrontal cortex is activated. When the limbic system is highly activated, there is a conflict between the “upward push” of emotionally driven urgency and the “downward regulation” of that impulsivity. *When a person’s PFC is functioning appropriately, the regulatory process channels energy away from the escalating emotional pressure by sending a neural impulse to the limbic areas of the brain that would otherwise be attuned to the upward push, thereby “down-regulating” the emotional systems*. The practice of mindfulness of breathing strengthens the functioning of the PFC. When practicing mindfulness of breathing, any distraction represents the “upward push” function, and intentionally redirecting attention back to the breath activates a “downward regulation” function. The repeated activation of the PFC operates to not only set aside distractions, but also develops the characteristics described in advanced stages of contemplative awareness: *inconstancy, dispassion, cessation and relinquishment*.

**TEMPEROPARIETAL JUNCTION (TPJ)**: This area is situated above and behind the ears and is the crease where the temporal and parietal lobes join. The left temporoparietal region (lTPJ) functions in the process of understanding the speech of others and the ability to infer what another’s intentions might be (Another process involving mirror neurons). The right temporoparietal junction (rTPJ) functions to pay attention to mental processes, particularly as related to emotional empathy. There is an emerging field of research regarding what is called “Theory of Mind”, which is a person’s ability to “think about thinking” in regard to one’s own internal processes, and, by inference, the mental states and intentions of others. In this regard, the rTPJ and surrounding temporal areas are strongly connected to the medial prefrontal cortex (mPFC), which, in turn is strongly connected to the insula. This whole system seems to cooperate in advancing the process of mindfulness.

**DEFAULT MODE NETWORK (DMN):** There is much contemporary research on what is called the “Default Mode Network” (DMN), which is associated with theory of mind. This network consists of strongly connected neural pathways involving the temporoparietal, prefrontal, cingulate gyrus, insular and hippocampal regions of the brain. The DMN is activated during the process of mind-wandering, which is typical of the normal function of anyone’s brain. *Mind-wandering is diminished in its presence and potency among well-trained mindfulness meditators.*

The impact of mindfulness meditation training on the functions of the brain and consciousness can be summarized as the increased interactions between the various neural networks briefly described above. This kind of awareness is similar to the process called “metacognition” and seems to be synonymous with vipassana practices. Mindfulness of breathing meditation practice is straightforward: We cultivate an intentional focus of attention somewhere around the nostrils, either at the upper lip, rim of the nostrils, or just inside the rim; an alternative function, as mentioned above, involves monitoring the expansion and contraction of the abdomen.

We then intentionally maintain a focused and contemplative quality of attention during the in-breath, sensitive to the changing texture of any sensations noticeable. These two behaviors activate the PFC, insular cortex and TPJ areas of the brain. The ACC is in “standby mode”, that is, alert for *error detection and conflict monitoring*. The “error detection” alerting process can monitor for *anicca*, *any change in either the physical sensations associated with breathing*, *any changes in peripheral awareness*, or *any changes in the quality of available attention*. This represents the onset of training for vipassana, insight into the three characteristics, anicca (ah-nee-chah), dukkha (doo-kah), and anatta (ah-nah-tah). Upon noticing distractions from investigating breath sensations, the insular cortex and ACC processes stimuli generated by the amygdala, hippocampus and nucleus accumbens, and then the “course correcting” actions of the PFC redirects the energy of attention back to the simplicity and neutrality of breath sensations.

The research is inconclusive, as it is very hard to control all the variables that might affect the research subjects’ consciousness. However, it is also encouraging and, for me, inspiring. Stated more simply than in the research, focusing attention on the neutral feeling tone associated with breath sensations activates the parts of the brain that regulate emotional reactivity. When attention wanders from breath awareness, the parts of the brain that are activated through exposure to novelty are activated and analyzed. The PFC functions to regulate the neural pathways within the limbic system associated with emotional arousal and increases internal vigilance regarding further novelty. Intentionally returning attention back to the neutrality and simplicity of breath awareness changes the structures of the brain to further develop these functions, creating increased internal awareness, combined with increased emotional self-regulation.

With dedicated practice, over time, internal sensitivity and mood regulation increases, revealing more subtle subjective manifestations of ego drives, along with increasing serenity and detachment from ordinary impulsive reactivity. This capacity is described as the full development of the Seven Awakening Factors, described in the Satipatthana and Anapanasati suttas as the culmination of the Awakening process.