Meditation, Neuroscience, and Well-Being

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Greetings, and thank you for inviting me to share a few remarks on the topic of meditation and neuroscience. The specific question I have been asked to address today is "How can meditation work for healing or enlightenment from the Buddhist perspective?" and though I will bring a scientific outlook to this inquiry, I speak not as a neuroscientist but as a scholar of early Buddhist thought and practice.

Shared Perspectives

The views of the mind and body put forward in ancient India in the texts attributed to the historical Buddha are similar in many respects to the scientific ways we regard these today, which is one of the reasons for the modern world's continuing interest in Buddhist ideas and practices. It is also a reason for looking to traditional lore to help us understand ourselves better, both to become as healthy as possible individually, but also to learn how to act more skillfully as we face many difficult current challenges together.

The first similarity I would like to acknowledge between the ancient and modern approaches to the topic of consciousness, and I am by no means the first to point this out, is a shared interest in empirical observation as a primary means of gaining knowledge. Early Buddhists rejected the appeal to revealed scripture, to popular opinion or conventional wisdom, to the often seductive powers of rationalization, and even to the unquestioned authority of one's own teacher. The Buddha insisted that his followers know and see things for themselves, through direct experience. While the neuroscientist primarily uses third-person techniques, studying the mind by looking at the brains of other people, the primary tool wielded by the ancient Buddhist was the first-person direct observation of one's own mind through the practice of meditation.

Another similarity is that in early Buddhist teachings consciousness is considered to be an emergent phenomenon. While eternalists both ancient and modern regard the mind as something essentially transcendent of the world, and materialists then and now think of the mind as an epiphenomenon or off-shoot of the material brain, classical Buddhist theory insists upon the thorough interdependence of mind and body. “Without veering toward either of these two extremes,” says one text, “the Buddha teaches his doctrine by a middle way,” i.e., consciousness emerges in an environment of multiple interrelated conditions. Among the metaphors used to rule out some of the conventional views of the day: mind and body are not identical, as a flame and its color; are not projected one from the other, like a shadow cast by a tree; are not contained by one another like scent in a flower or a jewel in a box; and the mind does not inhabit the body just as music does not live somewhere in a lute. While it may be the case that many neuroscientists are materialists at heart, the main target of their study is the functioning of non-material mental phenomena.

Here is another shared perspective between ancient and modern approaches to the mind: consciousness is seen not as a thing that exists but as an activity that occurs. Whether we use EEG sensors and fMRI scanners as a research tool, or focused awareness and open monitoring meditations, it is an unfolding process that is the object of our investigations. The firing of a neuron is an episodic event, with a beginning, middle, and end measured in microseconds. After “firing” it must rest before it is activated again. This is equally true of large arrays of neural systems whose activation is synchronized, resulting in pulsing patterns of globally coordinated activity interspersed with micro-moments of rest. In our sensors and scanners this shows up as oscillations of varying frequencies, corresponding to different expressions of processing activity. To the meditator it presents as moments arising and passing away in the stream of consciousness. One of the Buddha’s foremost followers, Sāriputta, is said to have had “insight into states one by one as they occurred…known to him those states arose, known they were present, and known they disappeared.”

One difference between the traditional and scientific approach to understanding the mind is the emphasis placed upon the spatial relations between mental components. Identifying specific regions of the brain and mapping out their connectivity has been a central agenda of modern neuroscience, while this matter is entirely unknown and irrelevant to subjective methods of studying the mind. From the Buddhist perspective, mind as activity does not "come from" anywhere or "go" anywhere. While it is understood that mental objects are dependent on a physical organ of the body, which they called the "heart-base" and we would call the brain, much like sight is dependent on the eye or sound on the ear, no consideration is given in traditional lore to spatial analysis of the mind, and in fact such imagery was discouraged. Sāriputta is said to have understood from his insight that "these states, not having been, come into being; and having been, they vanish."

The timing of mental events, however—what events happen when—is a matter of shared concern for both meditators and neuroscientists. The neuron, notwithstanding its extended network of spatial interconnections, is primarily a cell that performs its function in time, by firing for a precise instant. While it is clear that a massive amount of parallel processing transpires in the nervous system, along primary sensory pathways and by various mid-level sub-liminal parsing faculties, it is equally evident that subjective conscious phenomenal experience unfolds in a linear series. A lot is going on in the mind and body from the third-person point of view, but from the first-person vantage point we are only capable of really being aware of one thing at a time. This is a key insight of the meditative traditions, and though is appears otherwise it can be verified easily enough in direct experience. Research has exposed multi-tasking to be a folk-belief; in fact we are shifting attention rapidly from one object to another, synthesizing a sense of cohesiveness as we go.

The mind has evolved to handle most (and perhaps all?) of what we need done to stay alive in an automatic way, which is to say that most of its functions are governed by instinct, reflex, habit, conditioned response, and various forms of learned behavior that remain largely unconscious. Many of

these are genetically pre-installed into our operating system, much like software is installed in a computer, and is similarly updated as needed on a regular basis. It turns out that what we call conscious awareness, the sense of knowing what is happening in our experience as it happens in the present moment, has a relatively modest role to play. It is increasingly becoming clear that conscious awareness functions mainly to monitor what is already happening in the mind and body, rather than to initiate action, and its ability to change what is already happening is more limited than the popular ideals of free agency would suggest.

Returning to Sāriputta, we note that after gaining access to seeing the flow of the stream of consciousness, and following upon his recognition that these states appear out of nowhere and then vanish, he finally goes on to name what he sees: "These states were defined by Sāriputta one by one as they occurred." He does this by identifying each of the mental factors that are present in a given moment of consciousness. The early Buddhist model of the mind and body is built upon such empirical observations of what factors are active in the mind at any given moment.

Buddhist Models of Mind and Body

The classical Buddhist model of minimum mental function is built around the five aggregates and six sense bases. Each moment consciousness arises in dependence on a paired sense organ and its associated object, which are material, and based on this contact there co-arises three other mental phenomena: a feeling tone that is either pleasant or painful; a perceptual interpretation of the object that is learned through language and culture; and a specific grouping of mental factors covering a wide range of intentional and emotional responses to the object. The stream of consciousness is made up of moments of seeing, hearing, smelling, tasting, touching and thinking, and flows along intermingled with parallel streams of feeling, perception, and intention.

The more developed psychological models of the Abhidhamma add some depth to this picture by providing a more granular view. Consciousness is seen as arising each moment together with a host

of supportive factors, called *cetasikā* or mental factors belonging to that mind moment, much like a king is accompanied by his courtly entourage. Three of these attendants will be the other mental aggregates of feeling, perception, and intention, and four other factors are added (contact, attention, focus, and arousal) to amount to seven so-called universal mental factors that will always arise together in every mind moment. Another forty-five factors, grouped as six occasional factors, fourteen unhealthy factors, and twenty-five healthy factors, may or may not arise in various combinations. This is how Buddhist texts describe the phenomenological landscape it uncovers in meditation. Each mind moment is unique, and some particular pattern of co-arising mental factors emerges with consciousness moment after moment to shape the changing textures of lived experience. Each of the mental factors identified in the Abhidhamma tradition, insofar as they have a specific function, no doubt correspond to identifiable neural networks and phased arrays of synchronized oscillating activity. Varela's project of neurophenomenology, wherein first- and third-person mental events are mapped to one another, has yet to be fulfilled, but the work progresses steadily.

With only the basic set of seven universal mental factors present, the mind can be thought of as being in a default mode, and the mental system is operating on automatic pilot in an apparently random manner. It is not actually random, of course, because it is embedded in a matrix of cause and effect and is subject to a host of both internal and external conditions. Since attention is a universal mental factor it is always present, working like the rudder of a ship steering the mind to the next object, but in default mode, when the mind is wandering, there may be no hand on the tiller. Intention too is a universal factor directing attention, but the helmsman may be alert or asleep at the wheel, which is to say the decisions guiding where the mind goes next may be conscious or not conscious. In any given moment attention might be placed on some incoming environmental stimulus such as a sight or a sound, or it may be responding to a memory, an association, or some other internal mental object. All this seems to

correspond broadly to the functioning of the interrelated set of brain regions identified by neuroscientists as the default mode network (DMN).

The Role of Meditation

Anyone can take a moment to notice that there is a parade of thoughts, emotions, sensations, and feelings passing through the window of experience, but it takes more focused and disciplined observation techniques to see this in a sustained way. Just as scientists vastly expand their view of what they study by the use of various instruments, so too does mental training in the form of meditation enhance the ability of a person to observe the flow of inner mental states. Meditation is a tool to be used for the empirical investigation of the mind and its experience of the body. What meditation accesses is the linear flow of the stream of consciousness, as one observes the apparent rise and fall of mental states. Phenomena come in to view and then, because of the inherent impermanence of a neuronal event, they immediately expire.

The practice of meditation begins with attempting to influence some conscious control over the mind wandering taking place in the default mode, which involves, among other things, engaging the executive functions of the pre-frontal cortex. The primary tools we have for doing this according to Buddhist psychology are the six so-called occasional mental factors, the first two of which are directed thought (*vitakka*) and sustained thought (*vicāra*). Directed thought is the mental function of deliberately placing the mind on a particular object. This is where it starts to feel like we are thinking or acting "on purpose" or consciously and gain a sense of agency. We use this ability to steer our own course through the mind when we tell a story or solve a problem or otherwise intentionally move from one object to another. Directed thought breaks the continuity of the default mode network as we focus on a specific task rather than following the wandering mind. Neurologically, activity in the posterior cingulate cortex (PCC) and medial prefrontal cortex (mPFC) diminishes as the task-focusing apparatus of the fronto-parietal network (FPN), including the pre-frontal cortex (PFC) becomes active. Because the mind moves

as fast as it does we also need help from the mental factor of sustained thought (*vicāra*) to hold the attention on the chosen object once it has successfully made its way there. Working together, the ability to direct attention deliberately to a particular thought or object, and then be able to sustain that attention, serves to allow us to disengage from the automaticity of the default mode and enter into the intentional use of the mind. Classical texts refer to images of taming an elephant or bringing a chariot under some modest control.

Directed thought and sustained thought are powerful tools, but as with all tools, they may or may not do their work easily or successfully. Remember, we are engaging the mind moment-by-moment, and every moment is different. One might successfully place the attention on a chosen object, such as the breath or a mantra or a visualization, only to have it hijacked by a sound in the room, a compelling feeling tone in the body, or an apparently random thought that flutters into the mind. In the ensuing moments these become the objects of awareness, and the tools of conscious control are cast aside. When you do not direct the mind on an object, objects direct themselves to your mind. So much of the time we are not in control of our experience, but rather are carried away by it on an excursion, and we may get quite far along on the journey before we even realize we have been taken for a ride.

This is why so many people find meditation to be difficult when they first try it. The intention might be to direct the mind in specific ways, but the powers of habit and reflex are strong and carry the attention elsewhere at every opportunity. To meditate is to witness the interplay between the intentional and unintentional functioning of the mind. With increasing ability to wield attention intentionally and maintain its stability over multiple mind moments, one gains the capacity to see more clearly and monitor more effectively the objects arising and passing away in experience. The aim of focused awareness meditation is to reach a state of calm but aroused equanimity, a state in which the mind, like a bowl of water left to become still, will reflect accurately whatever object presents itself at one of the six doors of the senses and mind. The problem is that the mind is seldom allowed to become

so peaceful, as an array of mental factors impinge upon consciousness to hinder or obstruct its capacity to focus. Some of these hindering factors are relatively benign, while others can be the source of considerable distress and suffering.

Unhealthy States

When experiencing one of the afflictive emotional states, some combination of fourteen unhealthy mental factors listed in the Abhidhamma is present and pouring in on consciousness to interfere with its ability to see things as they actually are. Neuroscientists recognize this situation as corresponding to the activation of the sympathetic branch of the autonomic nervous system (ANS) by the hypothalamus, unleashing a flood of stress hormones and engaging the limbic system generally, and the amygdala in particular.

A classic list of five primary hindrances are the most immediate obstacles to a peaceful mind. The most common challenge for first-time meditators is restlessness, the factor that is present when there is too much agitation in the mind or body, followed by sluggishness when there is too little vitality. Here we can use phenomenological feedback to adjust the energy level in the mind and body and find a balanced state that is simultaneously tranquil and alert. Next one faces the natural tendency to want what is pleasant and not want what is unpleasant. The mental factor called sense desire pulls the mind toward some objects while the factor of ill will pushes it away from others. Here too it is possible to find the middle point between these two inclinations, a state of equanimity, and for the mind to simply be aware of something without favoring or opposing it. The final hindrance is the kind of doubt that weakens the mind, which can be counteracted by developing trust and becoming more resolute. With all five hindrances temporarily put to rest, the mind is able to become concentrated, a state described as “purified, bright, and unblemished.”

Yet even when we are able to wrest some conscious control from the default mode network by cultivating the activity of the pre-frontal cortex, and are able to establish some steadiness of mind, we

are not out of the woods. In addition to the five hindrances already mentioned, we face a virtual army of mental and emotional afflictions that can charge into the mind from unconscious realms at any moment. Foremost of these are the three primary toxins of greed, hatred, and delusion, but almost a dozen others are named and identified in the Abhidhamma and many variants of these are enumerated in later literature. At their worst these afflictions lie at the heart of the major mental health disorders that plague the modern world, expanding well beyond the annoying impact of the five hindrances. Restlessness can be amplified into worry, anxiety, fear, and panic; sluggishness can evolve into depression, chronic unhappiness, and despair; sense-desire may manifest in various forms of compulsion and addiction; ill-will in strong forms can result in hatred, rage, violence and cruelty; and doubt can grow into the crippling loss of confidence, trust, and self-esteem. Meditation practices may or may not help with the treatment of these many afflictions, and is certainly contra-indicated in extreme cases of any of them.

From the Buddhist perspective these are unhealthy mental factors that co-arise with consciousness to hijack the universal and occasional functions of the mind and turn the global mind moment into one of psychological affliction and mental suffering. Their presence is the cause of dis-ease and ill-ness, and the way of restoring well being is to eradicate them from the mind, first as momentary states and then as abiding underlying traits. One of the things that makes the harmful mental factors so ubiquitous and even compelling is that they are often useful, insofar as they can be effective in bringing about an outcome, and this is part of the seductive hold they have on us.

Taking greed and hatred as an example, all human beings are born with these as components of their basic instincts. They are useful for survival, which is why they have been naturally selected to remain in our gene pool, but they come at a cost to our well-being. These mental states are a source of suffering, both for ourselves and those around us, and as such they can be seen as an illness we are born with and that we carry as a chronic condition. When greed or hatred are enacted as mental states they

evoke behavior that causes harm to others, and provokes from others similar mental states that can result in harm to ourselves. They also damage us inwardly by strengthening the underlying tendencies toward greed and hatred—every time we act out an unhealthy state, it reinforces and amplifies its corresponding unhealthy traits. Physiologically this manifests as the stress response, flooding the body with cortisol, adrenaline, and other stress hormones, and putting the body into 'fight or flight' mode. While we know this can be helpful, and even necessary in dire circumstances, research has well documented the overall harm this does when sustained over time.

Meditation and Health

This brings us to the matter of health, and the relationship between meditation, health, and well-being. The fundamental paradigm of Buddhist thought and practice is of healing the mind of its afflictions by a process of purification, and meditation is the regimen that can bring this about. Just as a body is healthy when it is free of viruses, infections, and diseases, so too is the mind healthy when cleansed of its toxic mental factors. When the body is afflicted with illness, it can be treated at the level of its presenting symptoms or its underlying causes. So too does treating mental affliction involve mitigating symptoms for the temporary relief of suffering, by replacing unhealthy mental states with healthy states, and working to eradicate the deeper underlying causes of the illness itself, by replacing unhealthy mental and emotional traits with healthy traits.

In Buddhist thought the mind is regarded as being naturally healthy, only afflicted by toxins that are seen as external to the essential nature of consciousness. One way this is put:

> "This mind is luminous. It is defiled by the defilements that come into it, and it can be released from the defilements that have come into it."

The unhealthy mental factors cannot be eliminated by resisting or suppressing them, nor is accepting and acting them out in hopes of "getting them out of the system" going to be effective. Both strategies involve a form of craving and only make matters worse. The preferred method, enabled by

meditation practice, is to be aware of unhealthy states, understand that they cause harm to oneself and others, and "abandon" them. Open monitoring meditation practice trains us to abide "without clinging to anything whatsoever in the world," as a classic text puts it. Without either favoring or opposing unhealthy states, one allows them to be swept away by the natural laws of impermanence. They will come up again until their roots are pulled up, but as time goes on they will gradually do so less often, with less intensity, and for shorter duration. We often think of mindfulness training as learning how to focus attention on the next moment, when in fact it has more to do with learning to let go of the last moment. We can only notice what happens next by letting go of what is happening now. If we engage with present experience with any trace of holding on or pushing away, it becomes 'sticky' and we are no longer able to disengage from it.

Positive States

Whenever an unhealthy mental factor is not arising, it allows for healthy factors to emerge and exert their influence on the mind. It is a fundamental tenet of Buddhist psychology that the two cannot co-inhabit the same mind moment, though it is not uncommon for the two qualities of mind to alternate rapidly. When a person is hateful, they cannot at the same time be loving, though they might feel love and hate in different mind moments, even toward the same object. Just as deep internal unhealthy traits drive the human mind to cause harm and to suffer, equally deep and influential internal traits direct the mind to happiness and well being. The natural antidotes to greed, hatred, and delusion are generosity, kindness, and wisdom, along with their many affiliated factors such as compassion, equanimity, trust, and honesty. The good news is that whenever the mind is free from the influence of the toxins, even if only for a moment, it can naturally experience profound well-being.

The entry point for accessing healthy states of mind is mindfulness, which always co-arises with a remarkable eighteen other factors, according to the Abhidhamma. A moment of mindfulness is therefore also always a moment of equanimity, of lovingkindness, of generosity, and is always confident

and morally correct. Mindfulness also renders the mind tranquil and light, and it is said to become malleable and wieldy, suggesting that a healthy mind is also more open to the transformative processes of neuroplasticity. Meditation now goes beyond merely directing the mind consciously to an object, and goes beyond deflecting the poisoned arrows launched from the unconscious, and becomes a tool for actively developing the host of positive qualities that contribute to health and happiness. When mental states are routinely healthy, bringing temporary relief from afflictive mental factors, the mind is cured of the symptoms of suffering. This allows wisdom to gradually develop, further treating the underlying causes and working more deeply toward a final cure for the causes of suffering. Meditation trains the conscious mind to replace unhealthy states with healthy states, thereby transforming the unconscious mind, as unhealthy traits are gradually replaced with healthy traits.

Awakening One Moment at a Time

According to classical Buddhist teachings we are all afflicted with the disease of suffering, and the cure can only be found in final awakening. When the toxins that poison the mind from within—greed, hatred, and delusion—are uprooted once and for all, such that they may never arise again, a person is said to be awakened. This is a noble ideal for which to aspire, but is out of the reach of so many. What if, instead, we aspired to vanquish these toxins from the mind—one moment at a time? Is not a moment devoid of greed, hatred, and delusion an awakened moment? Such moments are accessible to everyone, and are inherently valuable, even if it is not possible to sustain them for more than an instant.

If your body were wracked with pain, would you not welcome relief even if it were temporary? And if you had long-term chronic pain that you knew was incurable, would you not be grateful for it to diminish, to whatever extent possible? This is the promise meditation holds for us all, that we can experience moments entirely devoid of suffering, and that we can also significantly diminish our capacity for causing suffering for one another. If we manage to do this now and then, for a moment

here and a moment there, might we not learn to do it more consistently? Eventually, we may even be able to change everything.