THE MODULATORY EFFECT OF MEDITATION ON EMOTIONAL WELL-BEING, BEHAVIOR MANAGEMENT AND BRAIN ACTIVITY FOR MUSIC COGNITION RESEARCH

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ABSTRACT

A growing body of research literature suggests that meditation can be successfully used to modulate a subject's response to situations that impair normal functionality such as anxiety, excessive emotionality, anger, depression and temporary loss of fine motor coordination in situations such as performance anxiety or stage fright, as well as inhibition of short-term memory retention and recall. Furthermore, there is a significant number of other aspects of behavioral and metabolic response to meditation ranging from an improved reaction to casual but stressful stimuli to significant behavioral response change such as lack of negative or uncontrolled emotional response, a much improved ability to cope and manage under-pressure situations as well as feelings of lasting happiness which modulate the perception of overall experience. This paper surveys the research literature studying the phenomenon of meditation from an emotional well-being, behavior management and brain activity standpoint with the purpose of making connections with possible research in the field of music cognition and also for stimulating the contributions to such research from the community of music professionals.

INTRODUCTION

Long-term habituation has a direct effect on the effectiveness of any activity or process and meditation techniques are not an exception. When practiced routinely, they increase significantly the capacity to access deep states of relaxation as well as increased awareness and sharpness of mind in ever-shorter periods of time. For advanced practitioners, such deep states of relaxation could be attained instantaneously or maintained continuously, without distraction, while living a normal urban life and, with special training, during the different stages of sleep (Wangyal & Dahlby, 1998; Nagendra, Maruthai & Kuti 2012; Sulekha Kandavel et al., 2016), especially in combination with CBT or Cognitive Behavioral Therapy (Onga, Shapiro, & Manber, 2008). As the majority of studies are done on experienced meditators, there is an increasing interest for research on how such techniques might affect subjects with little or no prior meditation experience as well as the relevance of such skills to non-meditators.

For example, music performance on string instruments is a field of professional activity that requires a concerted synchronization of a significant number of continuously perfected skills with regard to sight-reading (Eliott, 1982; Gromko, 2004; Grutzmacher, 1987), fine motor coordination as well as short and long-term memory (Guettler & Hallam, 2002; Williams, 1975) that are usually impaired to some degree, sometimes

debilitating, by performance anxiety. Meditation techniques that have a documented positive impact on stress management as well as on the anxiety-based inhibition of short-term memory retention and recall (Wilson & Roland, 2002; Williams, 1975) could potentially offer alternative coping mechanism for situations which involve short and long-term performance-related stress and anxiety.

REVIEW OF LITERATURE

It is only in the past few decades that the effects of meditation became the focus of research in scientific fields ranging from neurology, psychology, general medicine and quantum physics to clinical applications and studies of the physiological effects of such techniques. Studies using imaging techniques document changes in body and psyche at individual and group levels due to self-development or training in mindfulness via meditation techniques (Davidson et al., 2003; Miller, Fletcher & Kabat-Zinn, 1995; Gillani & Smith, 2001; Benson et al., 1990; Hagelin et al., 1999). Such studies entered mainstream as well as specialized press such as the *MIT Technology Review* (Newton, 2004) or the cover story of *Time* magazine discussing "The Science of Meditation: New Age mumbo jumbo? Not for millions of Americans who meditate for health and well-being. Here's how it works" (Stein, 2004). These studies focused mainly on changes occurring during or post meditation (Lutz et al., 2004; Davidson et al., 2003; Solberg et al., 2004; Takahashi et al., 2004) as well as "the enduring changes in moment-to-moment awareness of affective stimuli of long-term meditators" (Kurtzman, 2005).

Labeled also as an *altered state of consciousness* (Tart, 1969), meditation is a term used interchangeably between several possible terminological domains of definition such as: *action*, *method*, *means*, *purpose*, *goal as such* and *state of being*. In *Transformations of Consciousness*, Epstein and Lieff define meditation as training in both concentration and mindfullness through "a process of attentional restructuring wherein the mind can be trained both in . . . the ability to rest undisturbed on a single object, and in . . . the ability to observe its own moment-to-moment nature, to pay attention undistractedly to a series of changing objects" (Epstein & Lieff, 1986: 58).

Meditation techniques

The West has seen countless short-lived trends of every kind imaginable, driven by consumerism and the quest for meaning in life. Meditation, however, is not one of them. Although not a Western cultural staple due to its misperceived association with some form of religious exercise, the effectiveness of such techniques are nevertheless verified by generations of meditators with exceptional results in terms of self-discipline, control, and genuine states of lasting happiness (Ekman et al., 2005), observed empirically by researchers using the latest in scientific investigative techniques (Lutz et al., 2004). Such meditators trained upon methods described in a variety of sources such as Tsongkhapa's *Lamrim Chenmo* (Tsongkhapa, 1402) treatise of the Gelug school of Tibetan Buddhism or in the various *completion phase* practices found in the training manuals of the Vajrayana and other traditions.

Lamrim Chenmo, among a wealth of other complete instructions, describes the methods for the "calm abiding" or *shamata* meditation, with the final purpose of attaining *meditative equipoise*. This is defined as an undistracted state of mind, free of

the “extremes of elaboration” or excessive attachment and aversion which usually manifest in the form of obsessive, harmful thoughts and behavioral patterns, leading to anxiety, depression, anger, perpetual unhappiness, lack of joy, discontentment, etc.

The various methods described therein employ efforts of the *three aggregates* of body (i.e. activity: prostrations, walking meditation; posture: asana; mudra: gesture), energy (i.e. recitation: sutra; chant: mantra; different kinds of visualization) and mind (i.e. mindfullness, awareness, concentration, mindful-awareness).

Various methods of meditation were developed in order to serve the particular needs and propensities of those interested in using such techniques for a better quality of life and control of their own mind, body and overall behavior. While meditation is usually perceived as leading to meditative equipoise or the goal of meditation, it is also defined as a state of being as such, rather than a method employed in order to reach a particular state of mind. According to the highest levels of meditative practices in the Vajrayana tradition, *meditation* is in fact a *status quo* of utter inner tranquility which makes all ordinary experiences even more vivid, meaningful and highly integrated, a state accomplished when all the propensities of doing something about something cease completely while one rests in the uncontrived, unelaborated, natural state of being (Dudjom, 2002). This form of meditation is continuous and all mundane activities are recognized as the outer forms and manifestations of that state. For the accomplished practitioner of the Mahamudra and Dzogchen systems of Vajrayana meditation, there is no more differentiation between the three phases of pre-, during and post-meditation, at any given moment in time. Since such mind attitude is generative of an over-all state of balance and wellbeing, all aspects of musical praxis could be positively impacted by such practices, including the speed and depth of memory recall, reaction speed for sight-reading and improvisation as well as fine motor adjustments during performance, focus, rehearsing capacity as well as prophylactic strategies for avoiding injury and musician-specific professional disease.

Meditation effects

An important finding regarding the difference between meditation and relaxation as well as the profound physiological effects of meditation was a study realized by Solberg et al. (2004) providing evidence that simply sitting in a rested position with lack of focus does not produce the same effects as those seen in meditation. The study compared hemodynamic changes during extended meditations in experienced meditators versus non-meditators resting in a seated position for the same length of time. The study found that meditators had a significant decline in heart-rate as opposed to the non-control group during the first hour, with further heart-rate decline in meditators during the second hour (Kurtzman, 2005). As musicians are subject to significantly high levels of continuous performance-related and emotional stress, meditation may provide behavior and cognitive management safe alternatives to other types of intervention such as medication (Shonin, Gordon & Griffiths 2013) that may affect performance and may be prone to dependency and over usage.

Pioneering work in the meditation field of research employing the use of EEG (electroencephalogram) was realized studying Zen Buddhist meditators in Japan (Kasamatsu & Hirai, 1966) and Tibetan Buddhist monks in USA by Richard Davidson, Jon

Kabat-Zinn and cardiologist Herbert Benson. Characterized as the "mind-body maverick" (Roush, 1997), the latter is widely known for his work on *relaxation response*, a term coined by Benson that describes physiological alterations during a state of relaxation (Roush, 1997). He found that metabolism could be raised by advanced meditators, in this case Buddhist monks from Tibetan monasteries, up to a rate of 61% from baseline and also lowered down to 64% from baseline, depending upon the particular meditation employed (Benson et al, 1990). This was the largest variance ever recorded in experiments by a simple resting procedure (Mair, 2003) and proved that meditation produces the exact opposite effect of the body's physiologic reaction to stress:

> "Stress comes from any situation or circumstance that requires behavioral adjustment. . . . There is a secretion of adrenaline, nor-adrenaline, epinephrine, and nor-epinephrine. Those hormones change the mental, as well as the physical components of our body. They lead to increased anxiety, increased anger and hostility, increased mild and moderate depression. They contribute to high blood pressure, hypertension, most heart disease and angiopectorus. . . . Your thoughts can have enormous power" (Benson, 1998).

Aside from the obvious stress-management advantages posed by mastery of such meditation techniques, better control of the metabolic response by relaxation may offer musicians better management of learning and performing variables, including situations when temperature control has to be taken into account, as musicians often perform in improper temperature-regulated conditions.

Imaging Techniques

Benson's 1975 best-seller *The Relaxation Response* represented the "first scientific validation of meditative practice" leading to the advent of "stress reduction clinics in workplaces, hospitals, and other settings" (Newton, 2004). However, empirical analysis based on reliably collecting objective data about the mental effects of meditation such as developing a keen focus for long periods of time or a mind which no longer dwells on negative judgments along with ever-increasing levels of empathy and compassion (Newton, 2004) was possible with the advent of new research techniques based on Functional Magnetic Resonance Imaging or fMRI. Musicians who are prone to be quite dependent upon others' opinions about their performance and public persona, whose entire livelihood depends upon long-term mastery of highly sophisticated instrumental and singing skills, have a particularly high degree of exposure to problems related to habitual perfectionism (Wilson, & Roland, 2002).

Musical interpretation requires a high degree of capability in terms of empathic response in order to collaborate with other musicians for the creation of an ensemble work, as well as a high degree of emotional availability and set of adaptative skills in order to impersonate different characters or express accurately the original intent of an author for as close to perfection of a performance as possible. Such career requirements can make a musician prone to hyper-sensitivity to noise and therefore reduced capacity to tolerate background music in normal situations of everyday life (Kliuchko 2015) or subject to musculoskeletal, depression and anxiety disorders that can affect professional

musicians (Kenny & Ackermann, 2013). The imaging techniques made possible the objective study of the brain dynamics, suggesting that there is a direct correlation between activity in specific regions and particular moods and dispositions. For example, a significant degree of activity in the frontal areas is subsequently correlated with positive states of mind on the left side and with negative states of mind on the right side (Newton, 2004).

Mindfulness

Research on mindfulness meditation which combines physical postures, breathing techniques, imagery visualization, progressive muscle relaxation and, in some instances, Buddhist psychology (Gillani & Smith, 2001) demonstrated effects on brain and immune function (Davidson et al., 2003) following the practice. In a 3-year follow-up study on 22 patients diagnosed with anxiety disorder, Miller et al., (1995) found that the continuing practice led to a decrease in anxiety such as increased left-side anterior activation (a pattern associated with positive affect) and decrease in anxiety for patients with DSM (Diagnostic and Statistical Manual for Mental Disorders). Similar observations regarding a substantial decrease in anxiety levels were made by Gillani & Smith (2004) using Zen meditation as well as by Goleman (1988: 163) who found in his meta-analysis of MBSR or the *Mindfulness-Based Stress Reduction* technique that meditators had much better coping mechanisms and management effectiveness regarding daily stress, all the while experiencing a significantly lower stress impact from them. Furthermore, Grossman et al. (2004) found that mindfulness training leads to "dispassionate, non-evaluative and sustained moment-to-moment awareness."

Key players

Aside from the *Benson-Henry Institute for Mind-Body Medical Institute* at Massachusetts General Hospital, the University of California at Davis, as well as Princeton University, an increasingly significant body of meditation research was undertaken by the *Mind and Life Institute* in Charlottesville, Virginia. The latter sponsored a series of conferences open to the public, creating the framework for scientific dialogue between the Dalai Lama, Buddhist scholars, neuroscientists, psychologists and representatives from other fields of science on topics such as attention, mental imagery and emotion.

The *Mind and Life Institute* conference was co-sponsored by the Massachusetts Institute of Technology's *McGovern Institute for Brain Research* with the declared mission to ultimately understand the biological basis of all higher brain functions in humans and to initiate particularly larger studies of novice practitioners in controlled conditions. Neuroscientists Nancy Kanwisher (Goleman, 2008: 368) and Christopher Moore (Kerr et al., 2011) initiated meditative training-related research and the broader neurological implications of such training by studying the mechanics of perception, which are thought to possibly underlie the attention and mental-imagery aspects of meditation.

Another significant player in the field of fMRI meditation research is the Hubbard Foundation which in 2009 prompted a series of studies investigating the neuropsychological foundations of consciousness and meditation and their influence on brain functioning, health and society at large. This research was based on imaging technology measuring the changes in blood flow to brain areas associated with specific

brain functions at the *Applied fMRI Institute* in San Diego, California, using a Siemens 3T Trio TIM (Total Imaging Matrix) whole-body MRI scanner system (Siemens Medical Solutions, Erlangen, Germany), as stated on Hubbard Foundation's website at the time.

For example, studies at the Hubbard Foundation by Richard Davidson on Tibetan monks observing the influence of meditation on brain neuroplasticity and function produced "conclusive evidence that mental states, like meditation, can influence the function of a brain. […] findings clearly indicate that meditation can change the function of the brain in an enduring way" (Kornblatt, 2017). fMRI imaging showed that the brain of monks and novices became active in "regions that monitor one's emotions, plan movements, and generate positive feelings such as happiness. Regions that keep track of what is self and what is other became quieter, as if during compassion meditation the subjects opened their minds and hearts to others" (Begley, 2007:237). fMRI imaging data retrieved by the Hubbard Foundation displayed visual representations of the meditation-based cortical activation (Hubbard 2019):

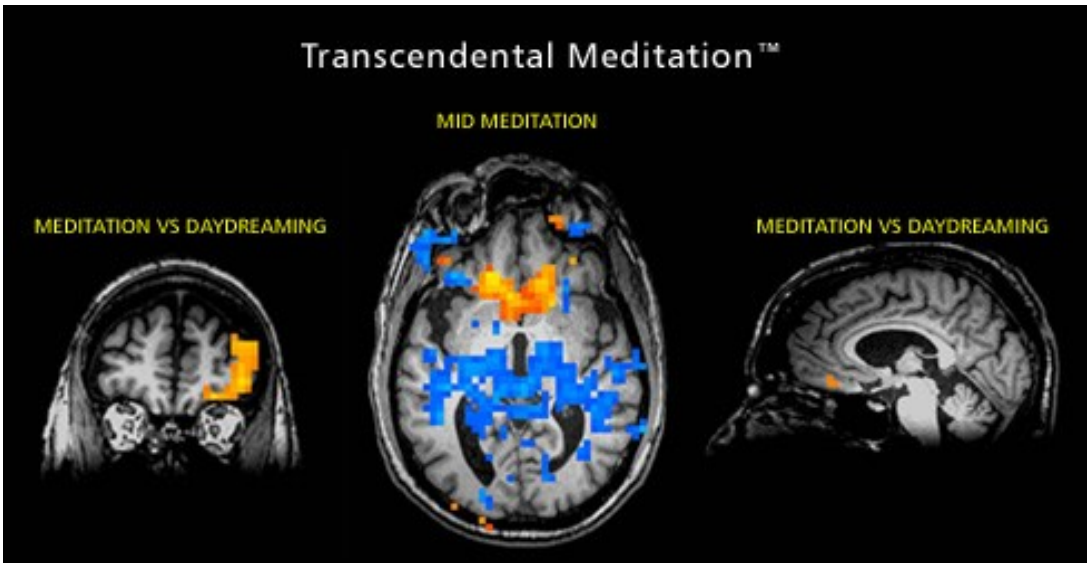

Image credit: Hubbard Foundation at www.hubbardfoundation.org/meditation. Used with kind permission.

Research pointing at similar results was also reported by James Austin in *Zen and The Brain. Toward an Understanding of Meditation and Consciousness*, based upon observations drawn from the Zen Buddhist tradition of meditation practices (Austin, 1999).

Other studies focused on how meditation affects brain response to depression (Burns, Lee & Brown, 2011), while Kalina Christoff focused on discerning what kind of brain activity is taking place when the mind is quiet as her studies have shown that simply resting with eyes closed implies, in fact, plenty of brain activity expressed as daydreaming, remembering, problem-solving and wandering. The brain activity during mind wandering is highly complex as it employs "the recruitment of large-scale neural networks" and it seems to have a close relationship with dreaming and creativity (Christoff et al., 2016). The effects of meditation on creativity are especially important for

music cognition research as the creative activity is the basis for interpretation, certain learning strategies such as improvisation as well as for creating new content.

Although Hubbard Foundation's orientation has migrated meanwhile to the vascular component of neurological disorders, with the declared mission "to develop tests for earlier recognition of brain abnormalities which may lead to neurological diseases," David Hubbard continues the fMRI meditation research as it results from a new fMRI study on Transcendental Meditation brain activation patterns (Mahone, Travis, Gervitz, & Hubbard, 2018). Furthermore, their website still maintains a *meditation* section showcasing fMRI imaging for Transcendental meditation, Deep meditation, Meditation vs. Dreaming and Vedic Chanting.

fMRI research on the mechanisms of meditation effect on brain activity was also undertaken by other researchers, among them being the UCLA psychologist Matthew Lieberman which scanned the brain of 30 subjects in order to reveal which parts are active and inactive at any given moment during the process and the effect of meditation techniques such as "labeling thoughts" or "letting go" on emotional response. Lieberman observed that "[b]rain scans show that putting negative emotions into words calms the brain's emotion center. That could explain meditation's purported emotional benefits, . . . people who meditate often label their negative emotions in an effort to 'let them go.' […] If you name your emotions, you can tame them," suggesting why meditation is effective in emotional management (Nakazawa, 2015: 216). Observations were based on levels of activation in the right ventrolateral prefrontal cortex region (thinking in words about emotional experiences) and the amygdala, (emotional processing). A second experiment led by David Creswell, a UCLA psychologist, was based on completing questionnaires in order to determine the level of subject's mindfulness. 27 of the same subjects participated and the conclusion was that "the mindful subjects experienced greater activation in the right ventrolateral prefrontral cortex and a greater calming effect in the amygdala after labeling their emotions" (McNeil, 2009:165). Creswell concluded that the proven beneficial effects of mindfulness meditation may explain "for the first time, an underlying reason why mindfulness meditation programs improve mood and health" (McNeil, 2009:166).

CONCLUSION

The last several decades brought about the advent of research in meditation techniques and resourceful proof of how they influence brain activity and the psycho-physiological response under different stimuli from the perspective of the mind-body connection. Other advances in imaging technology such as PET (Positron Emission Tomography) and SPECT (Single Photon Emission Computerized Tomography), may pave the way for more research on specific brain areas involved in emotions, thoughts and higher-level mind abilities such as meditation and prayer. Meditation has obvious benefits such as being completely non-invasive, easily accessible to a largest pool of subjects and highly effective when habituated properly, positively impacting attention, working memory capacity and reading comprehension. However, meditation in its many incarnations can also open access to a high degree of metabolic control which in itself poses a new set of interesting questions regarding other areas of interest such as better coping mechanisms for working under pressure, higher survival rates in extreme conditions, tapping into uncharted

human creative abilities, the effect of meditation on time perception and, eventually, enhancing space travel.

While music cognition is still in its early years as a domain of scientific inquiry, it has tremendous potential due to the proven effects of hand-on music education on brain development both during the maximum brain plasticity years of life as well as further on. Furthermore, a new direction of research could explore the combined effect of contemplative arts and music education on human development within the new paradigm defined by the advent of artificial intelligence.

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