

NEUROPHENOMENOLOGY OF AN ALTERED STATE OF CONSCIOUSNESS: AN fMRI CASE STUDY

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A research participant came to our lab with self-proclaimed, ecstatic, Kundalini meditative experiences. Using neurophenomenology and functional magnetic resonance imaging (fMRI), we were able to identify brain activation in the left prefrontal cortex [primarily in left Brodmann's areas (BAs) 46 and 10, but also extending into BAs 11, 47, and 45] associated with this experience. The Phenomenology of Consciousness Inventory provided evidence that this was a perceived altered state of consciousness. Additionally, the Physio-Kundalini Syndrome Index strongly suggested that what he was experiencing was indeed Kundalini. The feelings of joy, happiness and the left prefrontal brain region found in this study are consistent with many published neuroimaging and electrophysiological studies of meditation. This case study suggests that using first-person

subjective experience within a phenomenological reduction process can be combined with neuroimaging to divulge objective brain regions associated with such experiences. Furthermore, this provides evidence that at least in this participant, the Kundalini experience is associated with brain activation in the left prefrontal cortex. Future research is needed to confirm these results in a large group study, perhaps contrasting brain activation of those who experience spontaneously emerging Kundalini with trained Kundalini practitioners.

Key words: Neurophenomenology, Kundalini, meditation, fMRI, physio-Kundalini syndrome

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INTRODUCTION

Kundalini yoga meditation is an ancient Hindu technique, which includes stretching exercises, breathing exercises, chanting mantras, straightening the spine, and visualizing perceived energy flow along the spine that may lead to an ecstatic/euphoric state.¹⁻⁴ In some Eastern religions, it is considered as a pathway to spiritual enlightenment that is believed to produce physical and mental changes among practitioners.⁵ For the original religious perspective on Kundalini, please refer to the English translation of the Yoga-Kundalini Upanishads by Arthur Avalon,⁶ the nom de plume of Sir John George Woodroffe.

A number of research studies have been conducted to examine physiological changes in those practicing Kundalini. Some studies have employed psychophysiological measures of the autonomic nervous system (i.e., heart rate, respiration, and muscle activity) and other central nervous system measures [i.e., electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI)]. Two studies have shown a normalizing of heart rate, with a decrease in the variability, in Kundalini meditators from a database of electrocardiography data.^{7,8} In contrast to this, one research group showed an increase in heart rate variability using electrocardiography.⁹ Interestingly, another publication

revealed that Kundalini meditators were unable to accurately gauge their heart rate at rest, as shown with infrared photoplethysmographic device placed on a finger of the dominant hand.¹⁰ With regard to muscle activity in Kundalini meditators, as measured using electromyography (EMG) at the end of meditation, divulged that there was a decrease in resting muscle activity to that of 58%.¹¹ With regard to respiration, one study showed that Kundalini meditation was associated with a decrease in respiration (using an abdominal strain gauge) paired with an increase in alpha as shown in the EEG during meditation. Furthermore, there was increase in theta EEG post-meditation.¹² More recently, using fMRI, one study presented bilateral activation of the hippocampi using fMRI during the silent mantra of Kundalini meditation. They speculated that this might have some association with memory consolidation.¹³

With regard to hormone levels and Kundalini, one research group attempted to examine hormone level changes associated with Kundalini meditation in a group of depressed patients. The authors claim that within three to six months of initiating a Kundalini meditation practice, there was a significant increase in the turnover of neurotransmitters (i.e., serotonin, melatonin, and glutamate) and a decrease in metabolites [i.e., 5-hydroxyindoleacetic acid (5-HIAA) and monoamine oxidase (MAO)] and hormones (i.e., cortisol) in these depressed patients. However, as these measures were based on plasma and urinary metabolites, it is unclear how accurate this corresponds to authentic central nervous system changes. Furthermore, the authors claimed to see lowered basal pulse and heart rate because of Kundalini.¹

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A number of research studies have been conducted to examine health benefits of those practicing Kundalini. Many of these have focused on obsessive-compulsive disorder (OCD). One of the first studies on this showed significant symptom improvement in OCD with Kundalini training as shown on various scales including the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), with a group mean change of 54% in a sample of eight subjects.¹⁴ A second study also claimed there was significant evidence for a benefit of Kundalini meditation on those with OCD. Again, change was based on several inventories. After a 15-month follow-up there was a 71% improvement on the Y-BOCS with 11 subjects remaining.¹⁵ A subsequent review of these previous two OCD studies suggested Kundalini training for the treatment of other psychiatric disorders such as depression, phobias, substance abuse, learning disorders (i.e., dyslexia and attention deficit hyperactivity disorder), and sleep disorders (i.e., insomnia).³ Another research group had a review panel rate various published studies for anxiety disorders, including OCD, and alternative treatments.¹⁶ The authors claimed that the results of an earlier study¹⁵ did not show an authentic significant benefit for those with OCD based on Y-BOCS measure.¹⁶ In a comprehensive review article of various studies of alternative treatments for OCD, the authors concluded that there was only weak evidence for benefit of Kundalini meditation practices on OCD.¹⁷ Other publications have suggested the use of Kundalini meditation to benefit those recovering from substance abuse,¹⁸ stroke,¹⁹ irritable bowel syndrome/gastrointestinal disorders,² and recovery from cancer.⁴

Two studies have focused on personality traits and perceived changes in consciousness in relation to Kundalini. Thalbourne was able to show a correlation between transliminality (boundary thinness, related to schizotypy), the Kundalini Scale (Thalbourne's own measure of Kundalini-related experiences) and drug use (both prescribed and illicit). He suggested this association might provide evidence for a personality type that uses perceived mystical experiences to escape their negative realities. This could be those who use drugs to induce a Kundalini-like experience. Alternatively, this might include those who medicate to cope with uncomfortable Kundalini experiences as well.²⁰ Another group used the Phenomenology of Consciousness Inventory (PCI) to examine a group of 12 trained Kundalini practitioners. These meditators experienced significantly altered (increased) sense of perceptions of time, meaning, affect (joy and love), internal visual imagery, arousal, and self-awareness associated with Kundalini meditation in contrast to usual consciousness.²¹

The final area of Kundalini scientific research has focused on what is termed Physio-Kundalini Syndrome (P-KS), a physiological symptom constellation associated with Kundalini.^{22,23,5} As Kundalini is known to happen to some spontaneously, sometimes during life-threatening crises, in addition to those with the desire and practice to achieve it, this syndrome can be present in those not even aware of the cause.^{22,23} The syndrome is associated with perceived mystical experiences and a multitude of physical symptoms ranging from motor (strange postures, catatonia, changes in breathing

rate, and involuntary movements), somatosensory (tickling/orgasmic sensation, perceived physical sensations moving throughout the body, perceived dramatic temperature changes, moving pockets of such temperature changes, transient pains, and tingling), auditory/visual perceptions (internally perceived noises or voices, internally perceived lights/colors, and perceived illumination of body parts), and mental experiences (dissociation, ecstasy, negative emotions, perception of altered time, and a perceived expanded physical presence). These symptoms can be measured using the Physio-Kundalini Syndrome Index (P-KSI).^{22,23} It is possible that P-KS may be misdiagnosed as psychosis²² or be comorbid with psychosis.²⁴ However, there is a clear distinction between the two. Greyson demonstrated that these Kundalini symptoms, in general, are no more frequent among psychiatric patients (including those with psychosis) than in a non-psychiatric control group.²² Greyson continued his work using the P-KSI in another study. Here he examined personality traits and their hypothesized connection with the P-KSI. A multiple regression analysis was used to compare several other inventories of personality traits with the P-KSI held as the dependent variable. Significant connections were shown between this measure of P-KS and personality traits such as fantasy proneness, absorption (inward directed attention), dissociation and temporal-limbic hyperconnection (a measure of "mystical worldview" derived from interictal personality changes from those with temporal lobe epilepsy).⁵ More recently, Indian researchers showed deficits in executive and other neurocognitive functions in a case study of a woman with P-KS and comorbid transient reactive psychosis.²⁴

For this manuscript, there are many terms that may be confusing to the reader. The following are these terms as defined in the context of this manuscript. Kundalini meditation is associated with a Kundalini experience. This Kundalini experience can include ecstasy/euphoria, the sensation of energy moving along one's spine and any combination of experiences and symptoms which were described in the Physio-Kundalini Syndrome Index previously reviewed. Authentic Kundalini refers to an experience that is consistent with this rather than psychosis or any other cause.

Subjective Experience in Scientific Research

Can subjective experience provide science with anything useful? The influence of behaviorism on the first half of the 20th century created a mindset where subjectivity was considered as not only inferior to objective measures,²⁵ but full of confabulation, self-deception, and inaccuracies in judgment and memory.²⁶ Petranker²⁷ explained that subjective experience best fits into folk psychology, as the self-observer cannot be truly objective and removed from his/her own experience. As behaviorism dwindled in the second half of the 20th century, however, this mindset against subjectivity remained in place within scientific research.²⁵ Mainstream neuroimaging research relies heavily on objective behavioral measures of performance, responses or at the very least known stimuli presented to the subjects at known times and intervals from which to classify events and/or epochs in neuroimaging data. Without explicit behavioral measures or

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