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States of Consciousness, the qEEG, and Noetic Snapshots of the Brain/Mind Interface: A Case Study of Hypnosis and Sidhi Meditation

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Abstract

Noetic analysis is a methodology to quantify the mind during hypnosis, meditation, or other stimulus conditions/states of consciousness in a reliable and valid manner. The methodology uses retrospective phenomenological assessment (RPA) to comprehensively assess subjective experience. By having the participant complete a first person, self-report questionnaire, the Phenomenology of Consciousness Inventory (PCI), in reference to a short stimulus condition, the researcher can generate a "snapshot" of the mind, and its qualia, in reference to that condition. Using such an approach with the qEEG may be able to better decipher the mystery of the brain/mind interface during states of consciousness associated with hypnosis and meditation by giving quantifiable subjective referents to the neurophysiology of such stimulus conditions. QEEGs were obtained during a standardized hypnotic assessment, the PCI – Hypnotic Assessment Procedure (PCI-HAP), and also during sidhi meditation of a long-term TM meditator. The PCI was completed in reference to a sitting quietly period during the PCI-HAP and also in reference to sidhi meditation. On the PCI-HAP, the participant obtained a hypnotic responsivity index (HRI) percentile score suggesting moderate hypnotic responsivity. Concerning noetic differences between hypnosis and sidhi meditation, meditation was associated with higher scores on self-awareness, altered awareness, and altered experience (altered body image and meaning), in addition to greater feelings of love. Sidhi meditation was also associated with more alpha and higher beta activity than hypnosis, with greater high beta in the left pre-frontal cortex. How such qEEG differences may relate to differences in noetic experience was explored. This case study suggests that, when quantifying the brain with the qEEG, and the mind with the PCI, a "noetic snapshot" of the mind can be obtained that may be used to better quantify the brain/mind interface, and augment the ability of neurophenomenology to unravel the mystery of hypnosis, meditation, and possibly other (altered) states of consciousness.

Keywords
qEEG; noetics; phenomenological experience; altered states of consciousness; hypnosis; sidhi meditation; brain/mind interface; mind

1. Introduction

1.1 Hypnosis and Meditation

The clinical usefulness of hypnosis [1] and meditation [2] are undeniable, and their similarity [3, 4], intriguing. Yet comparisons and contrasts between the two techniques remain daunting: "The terms 'hypnosis' and 'meditation' are used to refer to a bewildering array of practices across different cultural settings and in different historical epochs." ([5], p. 313). So writes Jamieson in the introduction to his chapter: "A unified theory of hypnosis and meditation states" in the edited tome by Raz and Lipshitz [6], *Hypnosis and Meditation*. As the book illustrates, a fuller understanding of the dynamics of hypnosis and meditation, and their similarities and differences, must comprehensively investigate hypnosis and meditation across various different levels of analysis.

In support of such cross-level analysis, Jensen, Adachi, Tome-Pires, Lee, Osman, and Miro's [7] "scoping review" of hypnosis, suggests that *"hypnosis and hypnotic responding are probably best explained by more comprehensive models that take into account factors from biological, psychological and social domains"* (p. 63). Hence, differences and similarities between hypnosis and meditation are probably best assessed across multiple levels of analyses, and then scrutinized as to how these levels compare and contrast with one another. Is it hence no wonder that research on meditation and hypnosis has *"been fraught with oversimplification that have hidden differences across procedures and goals, changes in state, and individual differences"* ([8], p. 281)?

1.2 Noetic Analysis

1.2.1 Epistemological Underpinnings

Part of that oversimplification concerns researchers in hypnosis, meditation, and even psychology in general, having failed to take a more sophisticated, comprehensive, and articulated examination of the nature of subjective experience [9-12]. William James [13] over a century ago in his *Principles of Psychology* defined psychology as the study of consciousness: "*Psychology is the science of mental life, both of its phenomena and their connections. The phenomena are such things as we call feelings, desires, cognitions, reasonings, decisions, and the like*" (p. 1).

In contrast, the many decades of behaviorism during the last century erroneously suggested that a sophisticated and articulate analysis of the mind was unreliable, invalid, and impossible to quantify [14]. It was "physicalism" at its worst [15]. We disagree:

> *The mind can be quantified, as can quarks, the economy, or a neutron star: 'precise descriptive first-person reports about subjective experience' can be obtained in a reliable and valid manner. Physics became queen of the natural sciences because it wedded mathematics to the description of natural phenomena... By quantifying a phenomenon of interest, we then use mathematical tools and models to better predict and control our universe* ([16], p. 405).

This same model can be, and has been, applied to the mind [16-21]. There is a famous dictum in philosophy which states: "*Epistemology precedes metaphysics*." Epistemology is "*the study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity*" ([22], p. 280). Since what we know is a function of how we know what we know, epistemology must necessarily precede metaphysics/ontology, which concerns itself with the essence and nature of being, Hence, the level of epistemological analysis determines what will be assessed and analyzed.

The present paper reviews a methodology to quantify the *"noetic"* (the Greek word for *'mind'* is *'nous'*), or the mental/subjective, level of inquiry via reliable and first person self-reports in reference to hypnosis and also meditation. This is a level of analysis that has not been developed very well in hypnosis, meditation, nor in psychology at large. (Notice that the noetic, or subjective/mental, level was omitted from Jensen et al.'s, 2015 "scoping" review of hypnosis.).

We need to comprehensively quantify the qualia [23] of human subjective experience, i.e. the "*properties of sensations and perceptual states, namely the properties that give them their qualitative or phenomenal [our italics] character – those that determine 'what it is like' to have them*" (p. 507).

Why are such *qualia* important? We have a level of analysis to study the neurophysiology of the brain, and we have a cognitive-behavioral level of analysis to study human cognition/behavior. A *noetic level of analysis* is needed to study those subjective aspects of the brain typically called the *mind*. In addition, we need to comprehensively quantify the mind just as physics comprehensively quantifies physical reality. Furthermore, it is not going to be possible to find the mind (the qualia of human consciousness) underneath the knife of the neuroscientist or pulled from an fMRI (functional magnetic resonance imaging).

> This is the "hard problem" of human consciousness, as defined by Chalmers [24]:
> *The hard problem of consciousness is the problem of experience. When we think and perceive, there is a whirl of information-processing, but there is also a subjective aspect... Then there are bodily sensations, from pains to orgasms; mental images that are conjured up internally; the felt quality of emotion, and the experience of a stream of conscious thought* (p. 226).

To make any significant headway in better understanding hypnosis, meditation, other states of consciousness, and their relationship to awareness, attention, and the brain; we need a comprehensive *quantitative phenomenology* to scientifically investigate the mind. The need for such a perspective was lamented several years ago by Lifshitz [25] "*whereas scientists have access to a plethora of advanced methods for investigating brain and behavior, they face a dearth of techniques for the empirical analysis of phenomenology* [26]" ([25], p. 9).

The same complaint has been echoed more than a decade ago: "*A growing number of cognitive scientists now recognize the need to make systematic use of introspective phenomenological reports in studying the brain basis of consciousness*" ([27], p. 31); "*there is also the growing realization, however, that it will not be possible to make serious headway in understanding consciousness without confronting the issue of how to acquire more precise, descriptive first-person reports about subjective experience*" ([28], p. 2).

1.2.2 Noetic Analysis: Rationale

Noetic analysis [16, 21], built upon almost four decades of research, is a reliable and valid introspective methodology designed to quantify subjective experience from a first person perspective. The methodology uses first person self-reports, as assessed by well-validated inventories, such as the Phenomenology of Consciousness Inventory (PCI: Pekala, [29]), to quantify various dimensions of subjective experience.

Such inventories are retrospectively completed in reference to a preceding stimulus condition/state of consciousness, and allow for the various structures, or dimensions of consciousness associated with that stimulus condition/state of consciousness, to be not only quantified, but visually diagramed, and statistically compared. This process of retrospective phenomenological assessment (RPA) yields quantitative reliable and valid phenomenological data associated with various stimulus conditions, and consequently, their associated (altered) states of consciousness.

The methodology assumes stimulus-state specificity. This principle posits a relationship, when assessed across groups of randomly selected individuals, that the same behaviors in the same stimulus settings will be associated with the same phenomenological state, i.e. the same intensities and/or patterns of subjective experience; while different stimulus environments will be associated with differing intensities/patterns of phenomenological experience. (For a critique of the statistical and methodological underpinnings behind this approach, including that of stimulus-state specificity, see Pekala, [18])

Stimulus-state specificity can be considered a phenomenological variant of *psychophysiological isomorphism* [30] i.e. "*a one-to-one correspondence between mind and brain states*" ([31], p. 222), comparing rather the mind/behavior interface, while taking into account variables related to the stimulus setting. Combining such noetic data with corresponding neurophysiological data, such as the qEEG (quantitative electroencephalogram), may give the researcher a better means to map the brain/mind interface during hypnosis, meditation, and related states of consciousness by more comprehensively quantifying the subjective referents associated with the neurophysiology of the qEEG.

Such neurophenomenological approaches, as exemplified in the current literature [32], typically employ less comprehensive approaches to quantify subjective experience than is available with RPA inventories like the PCI. Interestingly, the PCI has previously been used by researchers investigating the neurophenomenology of hypnosis during an OBE (out-of-body) experience [33] and meditation-related kundalini [34]. Additionally, Markovic and Thompson [35] have theoretically addressed the neurophenomenological comparison of hypnosis and mediation via the *"phenomenological and neurocognitive matrix of mindfulness"* (p. 79) using a multidimensional model proposed by Lutz and colleagues. Markovic and Thompson cite the possible usefulness of the PCI and several of its dimensions (internal dialogue, imagery, rationality and volitional control) as *"additional relevant features that could be incorporated into future effects at mapping"* (p. 98) hypnosis and related states.

Noetic analysis is concerned with quantifying and analyzing the contents and processes of consciousness, i.e. the mind from a first person perspective (without necessarily referencing any neurophysiological processes associated therewith), and does so in a reliable and valid manner. Neurophenomenology, on the other hand, integrates descriptive phenomenology, its quantitative cousin, noetics, and the various self-report methodologies in between, with neurophysiology. Whereas neurophenomenology looks at the brain/mind interface; noetics is specifically concerned with empirically quantifying the mind/consciousness and its qualia. By defining and measuring the various structures and dimensions of consciousness, it includes the ability to quantify states, and altered states, of consciousness, visually illustrating both intensity (via radar graphs and pips: phenomenological intensity profiles) and pattern (via psygrams) parameters.

1.2.3 Questionnaires

The two main questionnaires that the author and colleagues have used with RPA for noetic analyses are the Phenomenology of Consciousness Inventory (PCI: Pekala, [29]), and the Dimensions of Attention Questionnaire (DAQ: Pekala, [36]). These instruments, respectively, quantify consciousness in general, and attention, in particular. The PCI has been especially useful in mapping the subjective experience of hypnosis and has been shown to have adequate construct and discriminant validity [37-48]. Predictive validity has also been assessed [49-55].

In addition, the PCI has been used to map and quantify such stimulus conditions (besides hypnosis) as: epilepsy [56] and schizophrenia [57], psi phenomena [58], mediumship [59], meditation [60], fire-walking [61, 62], charismatic leadership [63], music perception [64], shamanistic trances [65], holotropic breathing [66], an OBE within an NDE [67] and OBEs associated with hypnosis [33], drumming [68], a virtual reality environment [69], and religious/spiritual narratives [70]. The PCI has been translated into 14 languages; the DAQ has been translated into 4 (see www.quantifyingconsciousness.com for additional information).

1.3 The Present Investigation

This case study involves investigating the mind/brain of a long-term TM meditator while he is doing sidhi meditation, and also during hypnosis (when assessed with the Phenomenology of Consciousness Inventory – Hypnotic Assessment Procedure: PCI-HAP: Pekala [71, 72]). As Woody and Sadler [73] have observed, most "*hypnotic scales in widespread use... do not provide important information about the client's subjective experience*s" (p.40). The PCI-HAP protocol remedies that deficit.

During both hypnosis and meditation, a qEEG was obtained, while subjective experience was quantified with the PCI. The model, we believe, will illustrate the potential for combining noetics with neurophysiology, quantifying the subjective referents associated with differential qEEG activation during hypnosis and meditation.

1.3.1 A Brief Review of the Neurophysiology of Hypnosis and Meditation and Their Interface

There are numerous studies on the neurophysiology of hypnosis and meditation. The following several paragraphs will give a selected summary of a few of such studies relevant to the case study reported below, focusing on the overall EEG frequency band differences between hypnosis and meditation, but also including an fMRI study or two of relevance.

Hypnosis. Rainville and Price [74] almost two decades ago suggested that hypnotic protocols lead to changes in body relaxation and mental absorption, resulting in changes in brain activity, which, in turn, lead to alterations in body image and alterations in states of consciousness.

Jensen et al. [7] suggest that EEG-assessed measures of brain states during hypnosis show *"(1) a fairly consistent pattern of more theta activity among highs, relative to lows; (2) both increases and decreases in most bandwidths with hypnosis except for theta, which tends to show increases with hypnosis in both highs and lows,…"* (p. 42). Somewhat similarly in reference to theta activity, De Benedittis [75] wrote that the subjective experience of hypnosis, including hypnotic responses, tend to be associated with increases in both theta and gamma activity. Additionally, increased theta is associated with not only higher hypnotic responsivity, but an increased level of hypnotic responding, citing Ray [76], Williams and Gruzelier [77], and Jensen et al., [7]. However, as De Benedittis reported, these findings are not without controversy [78].

Jamieson and Burgess [79] found that a hypnotic induction was followed by state-like alterations in the organization of EEG functional connectivity in the theta and beta frequency bands in high-hypnotically suggestible participants. Terhune, Cardeña and Lindgren [80] investigated frontal-parietal phase synchrony during hypnosis as a function of hypnotic suggestibility. They found that *"highly suggestible participants reliably experienced greater state dissociation and exhibited lower frontal-parietal phase synchrony in the alpha2 frequency band during hypnosis than low suggestible participants"* (p. 1444). Cardeña, Jonsson, Terhune, and Marcusson-Clavertz [81] investigated neutral hypnosis across 37 low, medium, and high hypnotizables looking at baseline, a hypnotic induction, and multiple rest periods. They reported that hypnotic "*depth correlated moderately to strongly with power and/or power heterogeneity for the fast EEG frequencies of beta2, beta3, and gamma, but independently only among highs*." (p. 375); in other words, with high hypnotically susceptible individuals, their hypnotic depth was found to be significantly correlated with increased beta and gamma activity.

Landry, Lifshitz and Raz [82] completed a comprehensive and sophisticated "systematic and meta-analytic" review of neuroimaging studies of hypnosis. They concluded that in probing hypnosis, *"there remains little consensus concerning the neural mechanisms and a great deal of inconsistency among findings* [83, 84]*"* ([82], p. 92). Landry et al. suggested that the inconsistencies appear related to the multifactorial nature of hypnosis, combined with differences in the methodologies enacted across the various hypnosis studies. Although their initial review highlighted higher-order networks as implicated in not only hypnotic susceptibility, but also the experience of being hypnotized, and response to hypnotic suggestions; their results did not confirm the role of higher order networks. Rather, their results "*revealed that hypnotic responses correlate most robustly with activation of the lingual gyrus, likely indexing mental imagery*" (p. 92).

Landry et al.'s comprehensive review suggests the tremendous challenge that awaits a comprehensive understanding of the basic neural mechanism of hypnosis, let alone, the interface among brain, mind, and behavior; in addition to hypnosis's relationship to the many varieties of meditation.

Meditation. A well-designed study out of Australia [85] suggested that alpha and theta rhythms are enhanced in meditators with an average of 4 years of daily meditation experience; in addition to which beta (12 to 24 Hertz) and gamma (25 to 42 Hertz) activity is significantly enhanced in advanced meditators. De Benedittis [75] found that when reviewing EEG studies there was a significant increase in both alpha and theta activity during meditation [86], that was associated with an overall slowing of the processes of consciousness [87]. Such increases in alpha and theta wave activity tends to be correlated with states of inner calm and stability [88].

Citing Ott [89], Jamieson [5] suggests that increased gamma activity may play a crucial role in the euphoric meditational "samadhi" experience, "described in both the Yoga and Buddhist traditions, and perhaps the 'enlightenment' experience found in other contemplative traditions, as well as spontaneously occurring mystical experiences" (p. 333). Fell et al. [31] suggests that meditation results in a slowing of the 8 to 12 Hertz alpha rhythm to theta. With continued and diligent practice, beta and gamma are significantly increased.

Using the fMRI, Modestino [34] reported on an investigation of an individual with spontaneous Kundalini awakening. Kundalini awakening is associated with the subjective perception of psychospiritual energy flowing up the spine with concomitant feelings of euphoria and ecstasy [90]. Although usually the result of intensive meditation practices [91], the participant investigated by Modestino reported spontaneous awakening of the syndrome.

An fMRI was completed while the participant was experiencing kundalini. The PCI was retrospectively completed in reference to his kundalini experience. The kundalini experience was associated with activation of the left prefrontal cortex, i.e. primarily Brodmann's areas 46 and 10. The results suggested an ecstatic experience, with very high levels of joy (99th percentile) and sexual excitement (93rd percentile) as measured by the PCI, along with percentile scores above 90 percent for altered perception, altered meaning, absorption (99th percentile), altered experience (92nd percentile), and an alteration in state of consciousness (100th percentile).

Modestino summarizes by saying that the left prefrontal areas have been shown to be activated during meditation using various modalities, in addition to the fMRI. Goleman [92] wrote that when people are feeling good and in a positive mood – "upbeat, enthusiastic and energized;" there is heightened activity in the left prefrontal cortex. Modestino reports that other studies have confirmed that such activation is associated with happiness and joy: "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" ([34], p. 128).

1.3.2 The Present Case Study

Given the aforementioned, the present study sought to examine the neurophysiology (as assessed by the qEEG) and noetic experience (as assessed by the PCI) of a long-term TM meditator during both hypnosis (using the hypnotic assessment procedure of the PCI-HAP) and sidhi meditation. Specific questions were proffered: a) how does the qEEG during a sitting quietly period during hypnosis compare to sitting quietly during sidhi meditation of an advanced TM (Transcendental Meditation) meditator; b) is the use of the PCI helpful in differentiating the noetic experience of hypnosis from that of meditation in this particular participant; and c) might combining the PCI with the qEEG provide useful information in further elucidating the subjective referents associated with neurophysiology?

2. Method

This single participant case study is based on research done through the first author's private practice in West Chester, PA. Informed consent was procured. This research is in compliance with The Belmont Report and the declaration of Helsinki.

2.1 Participant

The participant for this case study is a 67-year-old white male with a 46-year history of TM meditation. The participant was also a participant/observer; he is the second author on this paper. KC was aware of the literature on hypnosis and meditation, being a clinical psychologist.

2.2 Measurement

2.2.1 Phenomenology of Consciousness Inventory-Hypnotic Assessment Procedure[1] (PCI-HAP)

The Phenomenology of Consciousness Inventory-Hypnotic Assessment Procedure[1] (PCI-HAP) [71, 72] is a state instrument used to assess hypnotic responsivity. The protocol consists of a pre- and post-assessment and a hypnotic induction protocol. For the pre-assessment, the participant reported if he experienced hypnosis before, and if so, how hypnotizable he felt he was at that time. He was also asked to estimate his subsequent level of hypnotic depth on a "1" to "10" scale (estimated hypnotic depth). Additionally, the participant was told to visualize himself in a hot tub and estimate the vividness of his visual and kinesthetic imagery. Finally, he was told to estimate how helpful the hypnotic session was going to be to help him with his issues and concerns.

The hypnotic protocol consists of a progressive relaxation protocol, but without the tensing ("a body scan"); followed by a "10" to "1" count while "you let your mind become more and more calm, more and more empty" ("a mind calm"). The participant is then asked to "have a wonderful and relaxing time" [93] while experiencing a mental vacation in his mind at his favorite place (the hypnotic dream or imagoic suggestibility item).

Next, the participant is asked to raise his left index finger (the finger response item - to assess as to whether the participant was alert during this time period or may have drifted off towards sleep). He is also instructed that his eyes are "heavy like lead" and asked to try to open his eyes (the eye catalepsy item). This is followed by a five-minute sitting quietly period wherein the participant is told to "just continue to experience the state you are in right now." The participant then has a 15 second pause to mentally review what he experienced. This is followed by the de-induction using a "1" to "5" scale.

2.2.2 The Phenomenology of Consciousness Inventory (PCI)

<u>The Phenomenology of Consciousness Inventory</u>. The participant subsequently completed the 53-item PCI in reference to the 5-minute sitting quietly period during the hypnotic induction. The PCI assesses subjective experiences across 12 major and 14 minor dimensions (in parentheses) of

consciousness in a reliable and valid manner: arousal, memory, attention (direction and absorption), imagery (vividness and amount), positive affect (joy, love, sexual excitement), negative affect (sadness, anger, fear), internal dialogue, rationality, volitional control, self-awareness, altered state of awareness, and altered experience (unusual meaning, body image, perception, time sense). (The PCI[1], complete with manual and EXCEL scoring program, is available at www.quantifyingconsciousness.com.)

2.2.3 Debriefing form

After completing the PCI, the participant completes a post-assessment debriefing form rating the vividness of his imagery in reference to going "on a vacation somewhere to a beautiful place and have a very relaxing and very wonderful time;" whether the participant opened his eyes during the eye catalepsy item; if he raised his finger when asked to do so (the *finger response* item); and whether he had fallen asleep on a 4-point scale (the *sleep state* item). These last two items were included in the PCI-HAP to determine if participants, especially when tested in groups, may have drifted off towards sleep. The participant is also asked to evaluate his depth of hypnosis (to measure the participant's self-reported hypnotic depth, srHD), and how helpful hypnosis was going to be to help with his problems or concerns (post-hypnotic therapeutic efficacy).

2.3 Procedure

Before the PCI-HAP began, an electrode cap (Electro-Cap, Inc., Easton, OH) was fitted to obtain a 19 channel qEEG for the subsequent hypnotic assessment, and also the sidhi meditation, conditions. The participant experienced the PCI-HAP, a 20-minute break, and then 20 minutes of sidhi meditation. The PCI-HAP induction was digitally recorded and event marked, so the qEEG administrator (the first author: RP) could differentiate the different sections of the PCI-HAP while the participant listened to the pre-recorded induction protocol. (A copy of the event marked protocol, digital/audio version of the protocol, and paper transcript of the protocol is available from the first author upon request.) The full PCI-HAP protocol was event marked into 11 sections, for a total time period of 28.04 minutes. This paper, for the PCI-HAP condition, reports on only the qEEG recordings obtained during a 5-minute sitting quietly period during the PCI-HAP (which was near the end of the protocol: after the eye catalepsy suggestion, but before the "1 to 5" de-induction).

After the PCI-HAP protocol (including completion of the PCI and debriefing form in reference to that protocol) and a ten-minute break, the participant then completed 20 minutes of meditation. The meditation protocol consisted of 10 minutes of Transcendental Meditation (TM) practice followed by 10 minutes practicing the TM-Sidhi (TMS) program [94]. The TMS practice is based on a meditation procedure called *Samyama*. Samyama [95] involves the combined simultaneous practice of *dhāraṇā* (concentration), *dhyāna* (meditation) and *samādhi* (union). It is used to obtain a deeper knowledge of the object of the practice, e.g. in the present study, compassion, and requires the participant to concentrate completely on an object until that object occupies all of his field of consciousness.

This practice is described in the Yoga Sutras of Patanjali [96]. Specifically for the present investigation, it involved: 1) practicing transcendental meditation for a period of time with the objective of establishing, as much as possible, 2) a state of pure awareness/inner silence; then 3) mentally introducing a "sutra", i.e. a word or short phrase, e.g. "compassion," and allowing the effect of the sutra to emerge into the participant's awareness. Step number 3 is then repeated every 15-20 seconds. The PCI was retrospectively completed in reference to the 10-minute sidhi meditation period.

2.3.1 EEG Data Collection

QEEGs were obtained during the standardized hypnotic assessment, the PCI – Hypnotic Assessment Procedure (PCI-HAP; Pekala, [71, 72]) as delineated above, and also during sidhi meditation. The amplifier used for the EEG acquisition was the Brainmaster Discovery 24E (Brainmaster Technologies, Inc., Bedford, OH; Collura, [97]), with an EEG bandwidth of 0.43-80 Hz, A/D conversion of 24 bits (resolution of 0.01 µV EEG, 0.4 µV DC), a sampling rate of 1024 samples per second (data rate to the computer of 256 samples per second), and an input impedance of 1000 GΩ (see Collura, [98], for technical details concerning the measurement of the qEEG).

QEEG signals were artifacted by S.A.R.A. (standardized artifact rejection algorithm; Keizer, [99]). The EEG data was subsequently processed with Neuroguide software (Applied Neuroscience Inc., St. Petersburg, FL), allowing the EEG data to be compared with the Lifespan Normative database [100]. This database has been normed, for both eyes open/closed conditions, with over 600 individuals (ages of 2 months to 82 years). The electrode montage adhered to the International 10-20 System, referenced to (A1-A2) linked ears, with NuPrep skin preparation gel, and Ten20 conductive paste. Electrode impedances were adjusted to be below 10 kΩ for all sensors (as determined by a Checktrode electrode tester).

The EEG recordings were acquired during eyes closed conditions in a waking-relaxed state, sitting in an upright position for both the PCI-HAP hypnotic assessment and the sidhi meditation conditions. The digitally filtered frequency bands, for metrics of absolute power, relative power, amplitude asymmetry, coherence, and phase lag were as follows: 1 to 4 Hertz (delta), 4 to 8 Hertz (theta), 8 to 10 Hertz (alpha 1), 10 to 12 Hertz (alpha 2), 12 to 15 Hertz (beta 1), 15 to 18 Hertz (beta 2), 18 to 25 Hertz (beta 3), and 25 to 30 Hertz (high beta).

3. Results

3.1 qEEG Neurophysiological Results

Figure 1 and Figure 2, illustrate the z-score analyses for absolute power, relative power, amplitude asymmetry, phase coherence, and phase lag for the eyes closed period during the PCI-HAP, and the (eyes closed) sidhi meditation, conditions, respectively. Overall, Figure 1 and Figure 2 are somewhat similar, suggesting that the qEEG of the sitting quietly period during the PCI-HAP is similar to sidhi meditation with especially high levels of theta activity across both conditions. However, there was greater alpha activity during sidhi meditation versus hypnosis. Conversely, there was greater delta activity during the hypnosis, versus the meditation, condition. (The participant reported possibly falling asleep during the hypnosis, per the debriefing form – see below.)

Additionally, alpha levels are increased during meditation, in contrast to hypnosis, for the anterior half of the brain. This difference is even more apparent for the beta, and especially the high beta, ranges for the sidhi meditation versus the hypnosis conditions for the left prefrontal area of the brain.

In support of significant anterior/posterior laterality for sidhi meditation versus hypnosis for high beta is the significant amplitude asymmetry for the high beta brain map, versus the meditation high beta map. Fp1 was found to be associated with several significant positive lateralities with more posterior sites.

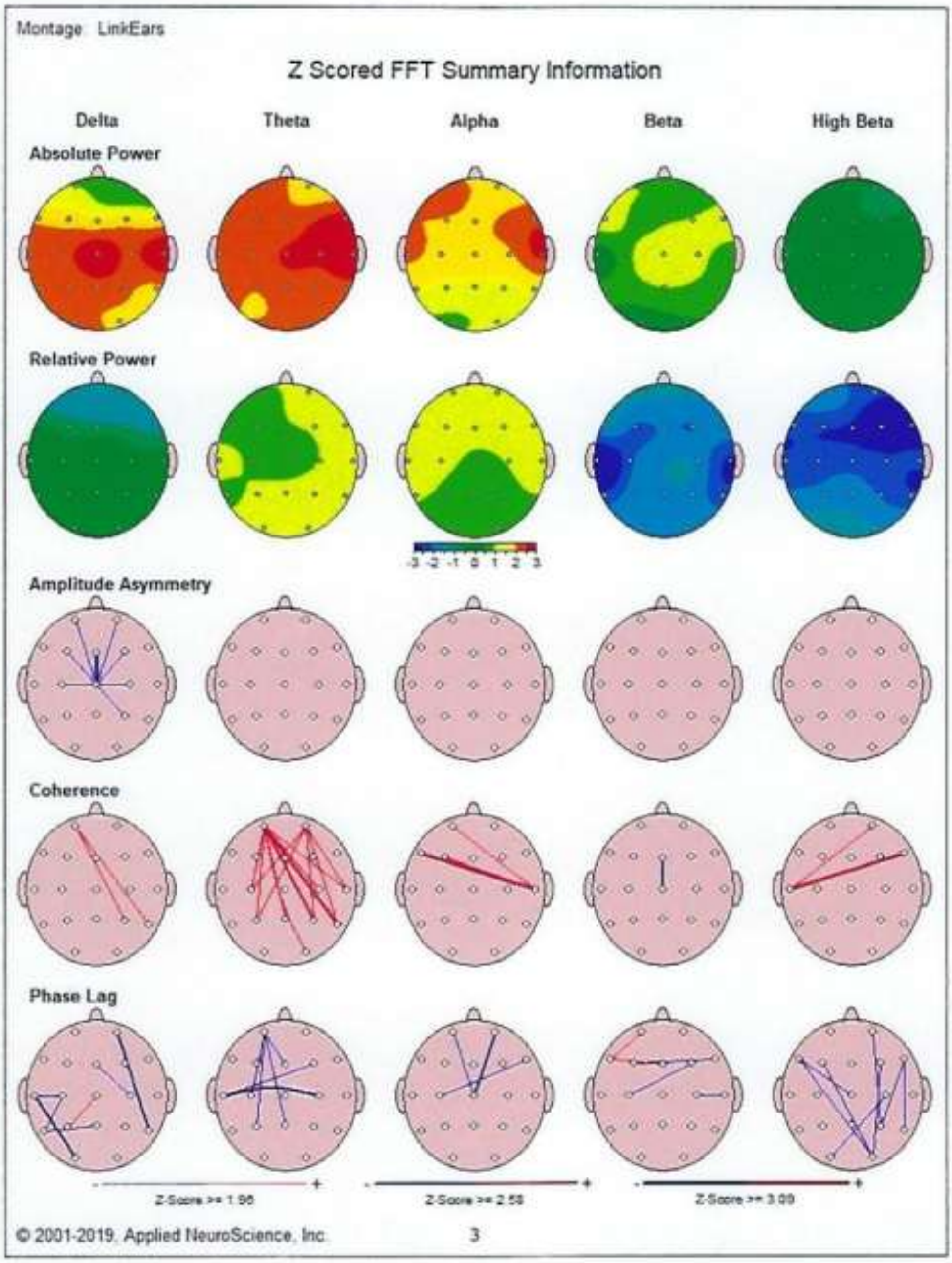

Figure 1 Eyes closed period during the PCI-HAP.

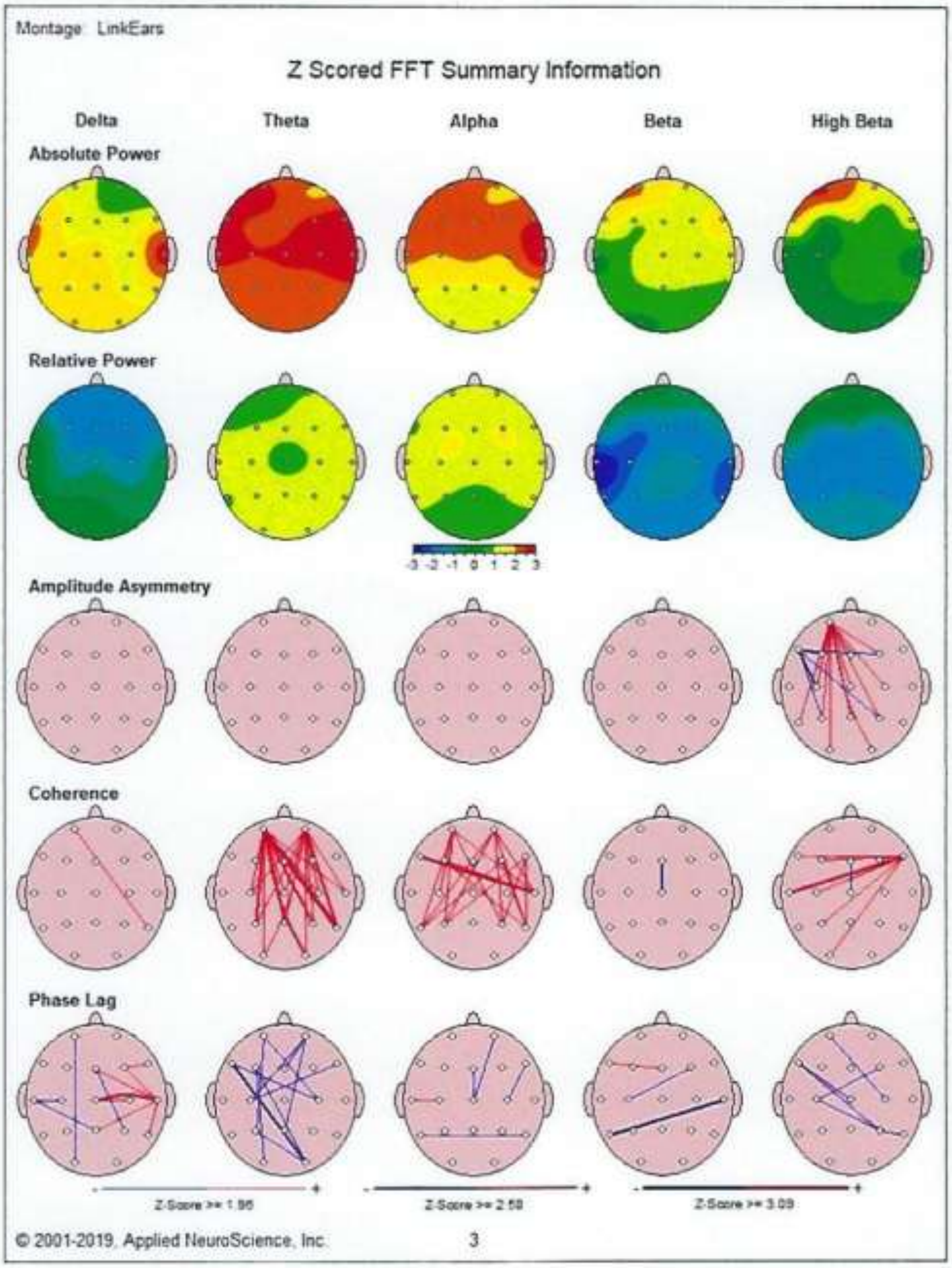

Figure 2 Sidhi meditation.

There was little significant coherence in the alpha band for sites for hypnosis, whereas there was more significant frontal to posterior coherence in the alpha band for sidhi meditation. In addition, there was significant coherence for frontal to posterior regions for hypnosis across sites for the theta band; in contrast, meditation was associated with somewhat increased theta coherence, versus hypnosis, across sites.

Figure 3 and Figure 4 show the 1-hertz bins for hypnosis and sidhi meditation, respectively, for 21 through 30 Hertz. The hypnosis brain map shows no left frontal increase in amplitudes for the hypnosis condition. In contrast, the sidhi brain map shows significantly increased left frontal amplitudes.

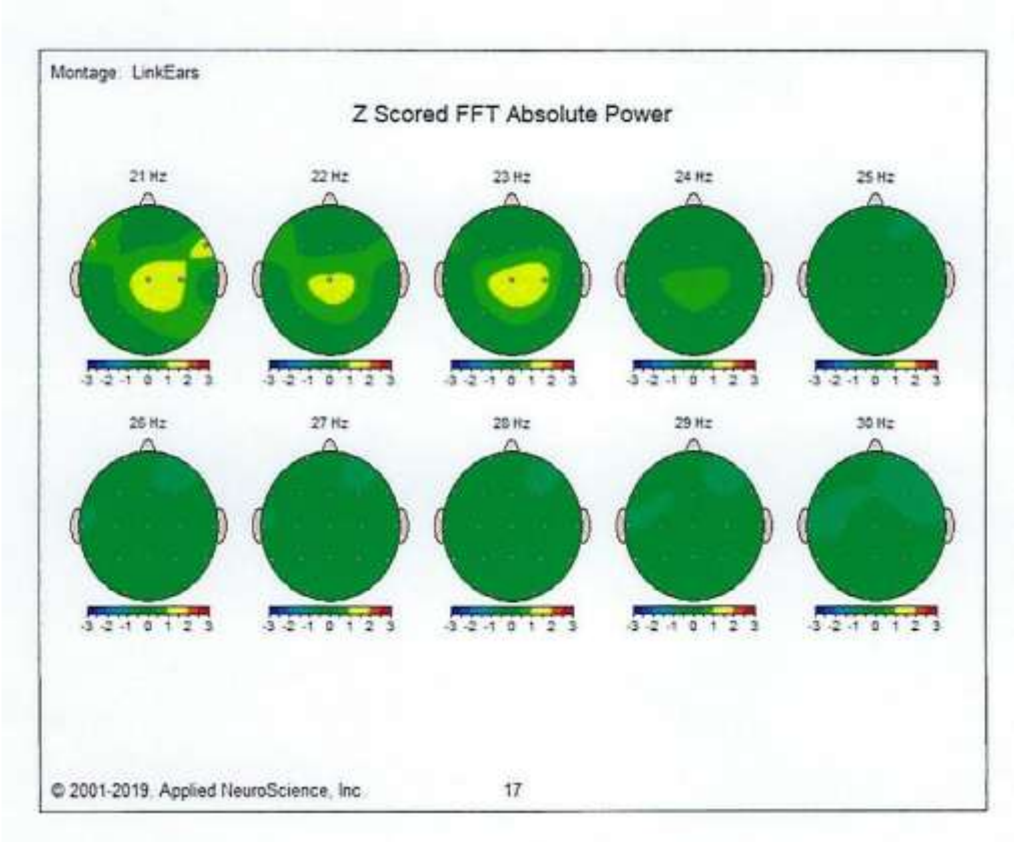

Figure 3 Eyes closed period during the PCI-HAP.

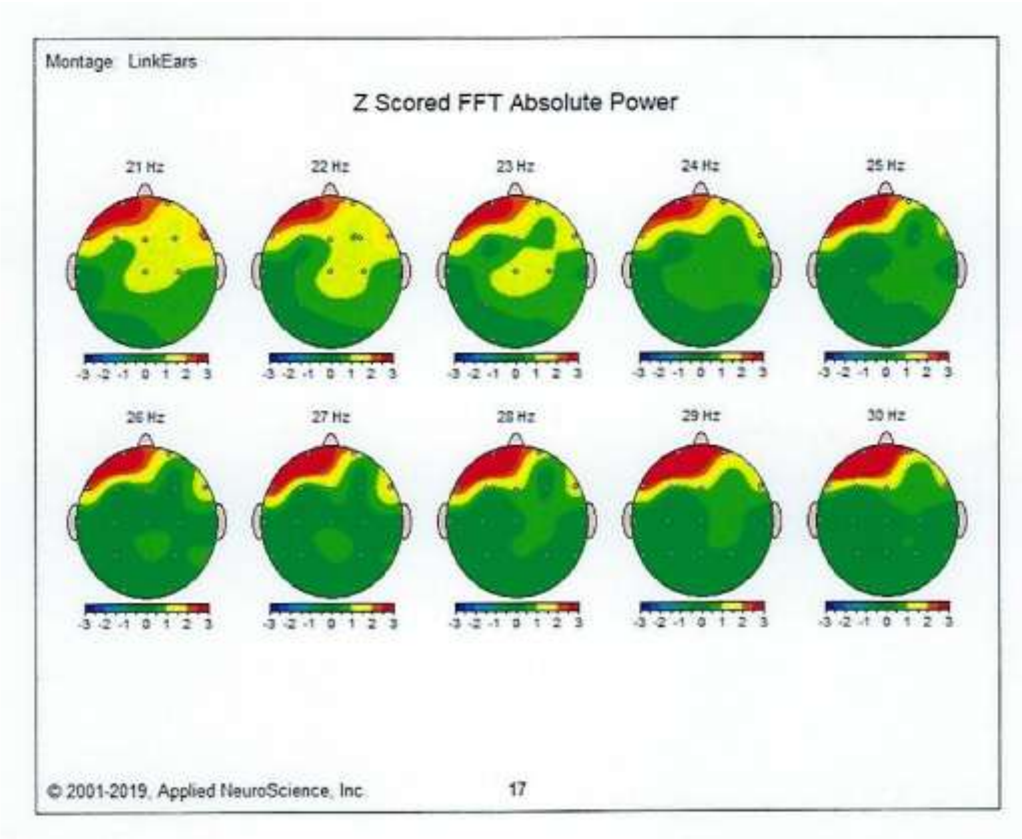

Figure 4 Sidhi meditation.

Table 1 shows the actual *z* scores for absolute power for the left, right, and center leads for the sidhi meditation condition. Only for Fp1 was there a significant z score for beta, beta 3, and high beta. There were no significant beta z scores for Fp1 for the hypnosis condition. Although not shown as a table, there was significantly higher delta activity across the majority of left, center, and right sites (11 out of 19 leads) for the hypnosis, but only T3 and T4 for the meditation, conditions (see Figure 1 versus Figure 2).

Table 1 Sidhi meditation.

Z Scored FFT Absolute Power								
Intrahemispheric: LEFT								
	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP1-LE	1.29	2.59	2.22	1.99	2.47	1.77	1.70	2.20
F3-LE	1.40	2.43	2.14	1.12	0.64	1.38	1.05	1.01
C3-LE	1.54	2.51	1.99	0.98	0.33	1.18	0.98	0.84
P3-LE	1.51	2.13	1.42	0.86	0.31	0.91	1.03	0.72
O1-LE	1.70	2.04	1.07	0.46	0.09	0.41	0.70	0.37
F7-LE	1.94	2.57	2.08	1.74	1.95	1.63	1.71	1.86
T3-LE	2.00	2.59	2.06	0.48	0.11	0.54	0.56	0.38
T5-LE	1.80	2.21	1.57	0.68	0.24	0.69	0.83	0.57
Intrahemispheric: RIGHT								
	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP2-LE	0.70	2.01	1.97	1.38	1.62	1.29	1.20	1.53
F4-LE	1.21	2.63	2.21	1.28	0.62	1.55	1.24	1.12
C4-LE	1.38	2.66	2.07	1.33	0.65	1.54	1.37	1.10
P4-LE	1.47	2.35	1.48	0.96	0.61	0.94	1.19	0.84
O2-LE	1.58	2.12	1.14	0.56	0.27	0.48	0.83	0.50
F8-LE	1.47	2.86	2.46	1.73	1.25	1.69	1.72	1.80
T4-LE	2.66	2.94	2.78	1.09	0.34	1.29	1.21	0.93
T6-LE	1.59	2.37	1.60	0.96	0.61	0.92	1.12	0.88
Intrahemispheric: CENTER								
	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
F_Z-LE	1.16	2.40	2.07	1.21	1.01	1.45	1.12	1.11
C_Z-LE	1.73	2.55	2.09	1.48	0.64	1.55	1.56	1.38
P_Z-LE	1.61	2.30	1.42	1.05	0.69	0.97	1.29	0.94

3.2 PCI/PCI-HAP Noetic Results

On the PCI-HAP, the participant obtained a hypnotic responsivity index (HRI) percentile score of 69%. Trance level (his hypnoidal state score) was at the 84th percentile, and imagoic suggestibility was the 59th percentile. A person's HRI is an average of the aforementioned items, plus "total expectancy" and the "self-reported hypnotic depth" score [101]. These results suggest that the participant was of moderate hypnotic responsivity. In reference to item #4 of the debriefing form, the participant endorsed: “I probably fell asleep, but I’m not sure,” suggesting the participant thought he may have drifted off towards sleep during the hypnotic protocol.

The PCI-HAP generates a 5-page report concerning the client’s hypnotic responsivity. Page 3 of the EXCEL report is shown as Figure 5. The upper graphs (left-sided) represent the PCI major and (right sided) minor dimensions in terms of raw scores (on a “0” to “6” scale); while the lower graphs represent the percentile scores for the major and minor dimensions, respectively. This allows the researcher to obtain a “snapshot” of the client’s mind for a given stimulus condition in reference to the intensity variations associated with the PCI (sub)dimensions.

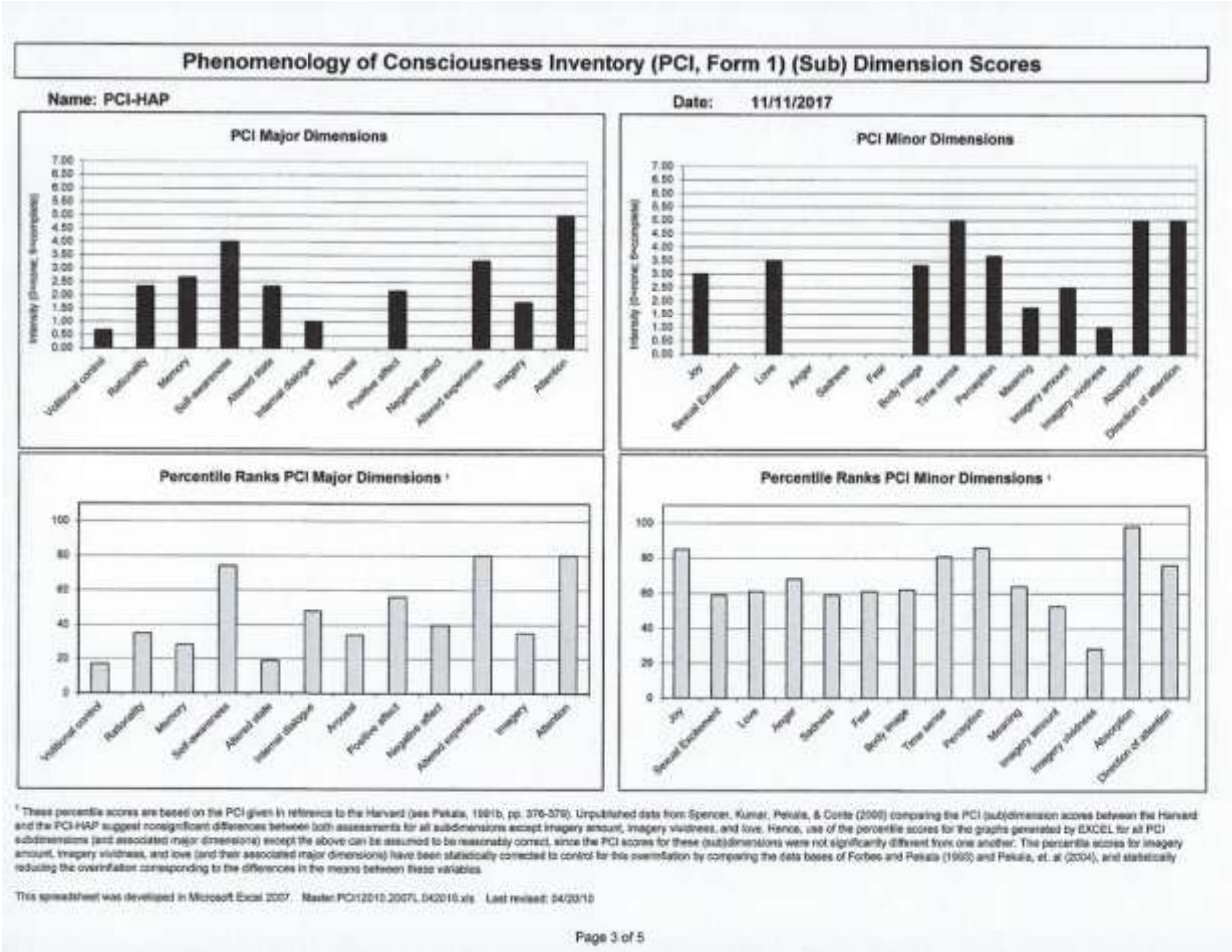

Figure 5 Phenomenological Intensity Profile (PIP) during the PCI-HAP (Eyes Closed Sitting Quietly).

Notice that the participant reported very high levels of absorption during hypnosis (98th percentile). No negative affect (neither anger, sadness, nor fear) was reported, although feelings of joy (85th percentile) and love (61st percentile) were reported. Imagery vividness was at the 28th percentile; while imagery amount was the 53rd percentile (See Pekala, [101], for the interpretative manual for scoring and interpreting the PCI-HAP results.)

Figure 6 (PCI major dimensions) shows the radar graph of sidhi meditation versus hypnosis (as measured during the sitting quietly period during the PCI-HAP), and eyes open and closed conditions for the PCI major dimensions. The center of the circle represents a value of “0” (“none or little”); while the circumference, a value of “6” (“much or complete”). Sidhi meditation was associated with no internal dialogue, compared with very mild levels of such during hypnosis. Notice also that the eyes open and eyes closed conditions – from the Pekala et al. [48] data base -

were also higher for internal dialogue than sidhi meditation.

Both altered awareness, self-awareness, and altered experience were also higher during sidhi meditation than during hypnosis (see Figure 6). Self-awareness was rated to be intense: "6" out of "6": "I was very aware of being aware of myself; my self-awareness was intense" (right dipole of item 13 from the PCI, Form 1). Concerning Figure 7 (PCI minor dimensions), what is striking is the higher level of love (also rated "6" out of "6") during sidhi meditation compared to hypnosis and the other two conditions.

Additionally, sidhi meditation, per the PCI, was associated with an increased altered body image effect versus that of hypnosis, and also an increase in altered meaning. During this time KC reported his phenomenological consciousness as having a sense of "unboundedness," with consciousness seemingly "expanded;" his sense of awareness was intense. He reported that his consciousness was "floating," "immersed" in feelings of compassion.

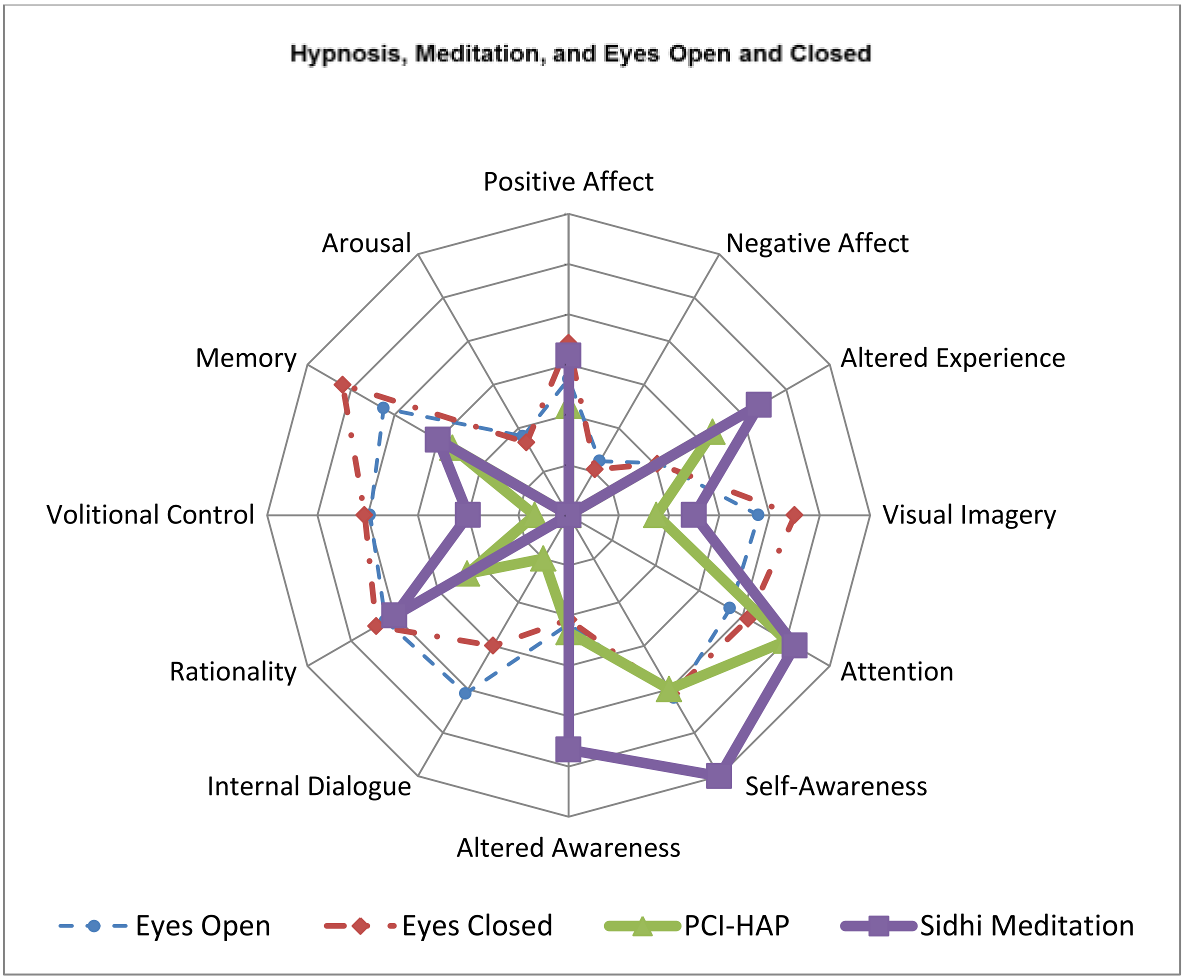

Figure 6 Radar graph of PCI major dimensions.

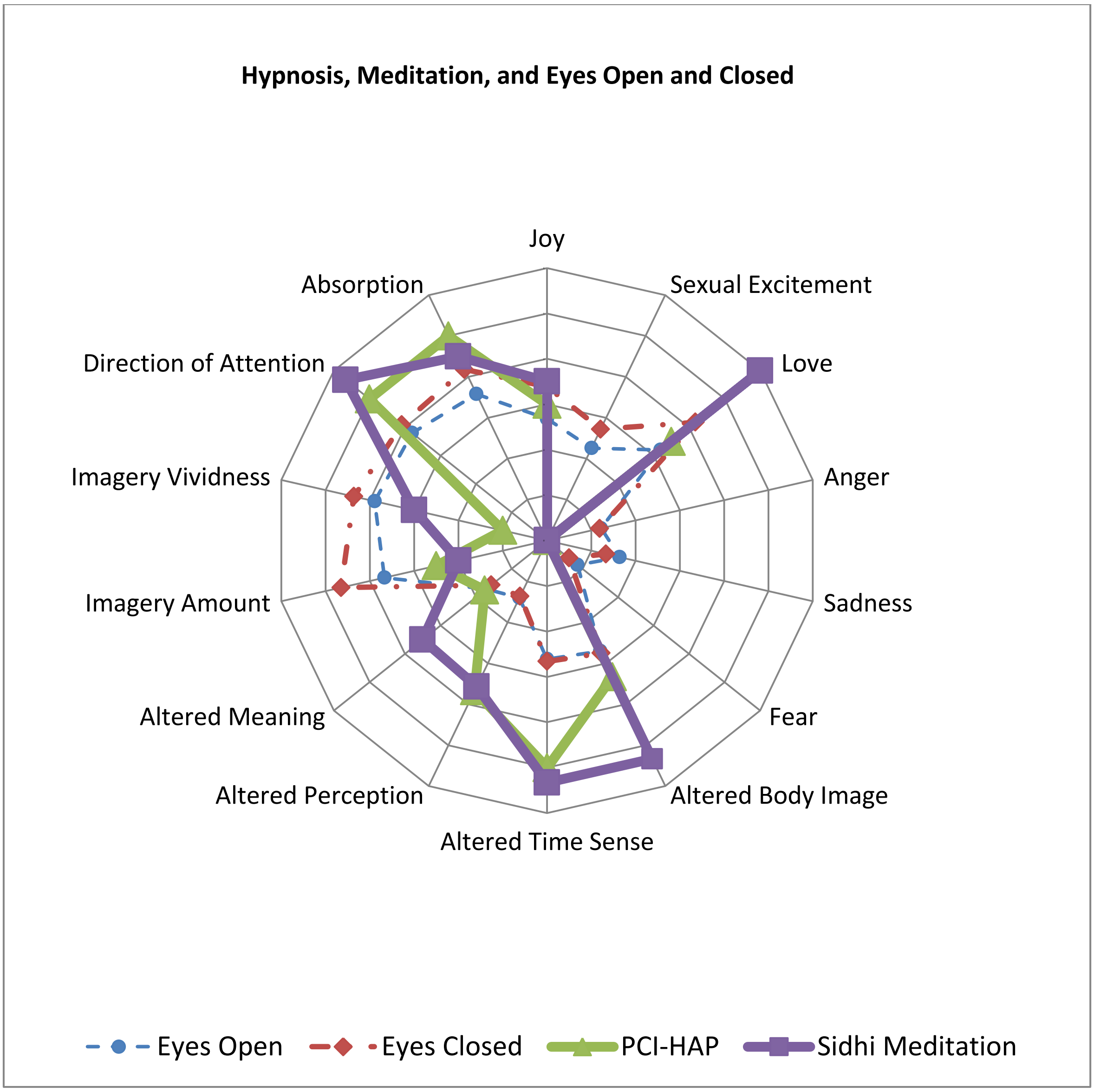

Figure 7 Radar graph of PCI minor dimensions.

4. Discussion

4.1 Neurophysiological Findings

The long-term TM meditator had significantly higher levels of alpha and especially theta activity across both the hypnosis and meditation conditions, congruent with the findings of Thomas et al. [85] and De Benedittis [75] for meditation, and Jamieson and Burgess [79], De Benedittis [75] and Jensen et al. [7] for hypnosis. Whereas there appears to be no significant increase in high beta activity during hypnosis for this moderately hypnotizable individual, there were such increases in the left frontal lobes during sidhi mediation, consistent with the theorizing and research of Fell et al. [31], Thomas et al. [85], and Modestino [34].

Interestingly, there was significantly more delta during the hypnosis, versus the meditation, conditions. This would be consistent with the participant endorsing "I probably fell asleep, but I'm not sure" (on the debriefing form of the PCI-HAP); which would also be consistent with less self-awareness during the hypnosis, than the sidhi meditation, condition (see Figure 6).

There was only very mild significant coherence in the alpha band for hypnosis; whereas there was more significant frontal to posterior coherence in the alpha band for sidhi meditation. In addition, there was significant coherence for the frontal to posterior regions for the theta band for hypnosis; in contrast, meditation appears to have increased that theta coherence. Coherence can be considered a measure of functional connectivity [102] among the different modules of the brain: *"EEG coherence may yield information about network formation and functional integration across brain regions"* (p. 42).

These results suggest that sidhi meditation was associated with increased alpha and theta coherence versus hypnosis for this moderately hypnotically responsive individual. Beauregard and Paquette [103] wrote that *"theta connectivity between frontal and posterior association cortices in the left hemisphere has been proposed to be related to positive emotional experience"* (p. 3).

Fell et al. [31] and Thomas et al. [85] report an increase in alpha/theta activity in relatively novice meditators, followed by increased beta and gamma activity in advanced meditators. To paraphrase Fell et al. [31], the research on long-term meditation experts suggests both an increase in synchronization and power of low frequency oscillations, along with an increase in synchronization of gamma waves. They point out that this is typically unusual since an increase in feelings of relaxation and a drop from alpha to theta (sleep transition), is usually associated with decreased synchronization and power in the gamma range.

Thomas et al. [85] in their research with medium and long term Satyananda Yoga meditators, found increased theta activity in intermediate Yoga meditators, while advanced Yoga meditators demonstrated *"greater activity in high frequencies (beta and especially gamma[2]) in all conditions but greatly expanded during meditation practice"* (p. 1), The increased theta and high beta qEEG results for this long-term sidhi meditator appears consistent with that of Thomas et al. above, although the high beta of KC, was much more left, than right sided, as was the case with the Thomas et al. study.

4.2 Neurophenomenological Findings

We believe that the PCI noetic results can be used to supplement and augment interpretation of the EEG results, which give no indication as to the nature or the content of the subjective experience, the qualia, or subjective referents, associated with both conditions, nor the intensity of such qualia. Before commenting on those results, however, the PCI-HAP hypnotic responsibility index (HRI) of the participant suggests that he was moderate in hypnotic responsivity. As of moderate hypnotically responsivity, his phenomenology is hence likely to be less similar to the very highly hypnotizable participants tested by Cardeña [104].

Concerning Figure 6, which lists a radar graph of the PCI major dimensions, the meditation condition was associated with increased self-awareness and somewhat increased altered experience versus hypnosis. When queried about this, the sidhi meditation condition was experienced (the subjective sense of consciousness) by KC as "a sense of unboundedness," that was not evident during the hypnosis condition. This sense of "unboundedness" is hard to put into words. It might be described as a different type of awareness that is not so focal as in normal waking consciousness; more diffuse, but yet somehow expanded – as if the aperture of consciousness had been "widened." (Notice from Figure 7 that body image, and meaning were all more altered during the sidhi meditation than during hypnosis.) The increase in alpha and theta activity in sidhi meditation, along with the increased fast beta activity, seems to juxtapose both a "slowing" of consciousness [75], and yet it's (beta) activation, consistent with the Thomas et al., paper [85] concerning the EEG effects of long-term meditation and the Fell et al. [31] novice/advanced "meditation frequency band hypothesis."

Per the PCI, there was no internal dialogue during sidhi meditation (the internal chatter than goes within one's self), versus very mild internal dialogue with hypnosis and moderate amounts of such dialogue for the baseline eyes open and closed conditions (across groups of subjects from a prior data base, [48]). These results are consistent with the meditation literature wherein the object of the meditation is to quiet and empty one's mind (samyama) [105], and moderate drops of such internal dialogue, as reported, during hypnosis [18].

Per KC, it is important to note that the TM samyama practice versus hypnosis generated relatively different subjective states of consciousness. Heterohypnosis, in general, involves a passive state wherein the individual responds to the hypnotherapist's suggestions. On the other hand, the TMS procedure is more active and requires an initial period of meditation and then involves the participant deliberately introducing a sutra into the mind with the intention/ expectation that it will produce a certain subjective effect while becoming "immersed" in the experience.

KC explains that the sidhi mediation condition is a more "active" process than the more "passive" hypnosis sitting quietly period: *"for the next several minutes I'm going to stop talking and I want you to continue to experience the state you are in right now"* (instructions for hypnosis sitting quietly period: Pekala, Kumar, & Maurer, [93], p. 11). This would be congruent with less loss of volitional control during meditation than hypnosis, as seen in Figure 6.

The arousal dimension of the PCI assesses "subjective tension." Both meditation and hypnosis were associated with no subjective arousal/tension. This would be consistent with the increased alpha and theta activity found across both conditions. However, KC reported "complete" self-awareness during sidhi meditation ("6" out of "6"), whereas self-awareness during hypnosis was "3.33" out of "6.0". Drops in self-awareness are typical of hypnosis [18, 37, 38].

One of the goals of meditation is to try to always maintain reflexive self-awareness [105], and a long-term meditator would be expected to do that well. Hence, meditation appears to increase "meta-awareness," e.g. reflective self-awareness [106], consistent with KC's self-awareness score. Such increased self-awareness is also consistent with left high beta activation [107] as was found for KC during meditation, but not, hypnosis.

In addition, there were intense feelings of love ("6" out of "6") reported during sidhi meditation; more so than hypnosis. We believe this is consistent with the "cultivation" of compassion that was generated during the sidhi meditation from the sutra repetition. Interestingly, both hypnosis and meditation were associated with moderate levels of joy (see Figure 7). Here, in this advanced TM meditator, greatly increased love (and moderate joy) was also associated with increased beta activation of the left prefrontal cortex. Interestingly, Kundalini [34] was also associated with positive feelings of joy (and sexual excitement) with concomitant activation of the left prefrontal cortex. Per Davidson [108], one of the activities of the left prefrontal cortex is to downregulate negative affect associated with the amygdala, which, in turn, may then be associated with increased positive affect.

Concerning the theta activity, theta increases as one falls asleep and also when awakening in the morning, i.e., the hypnogogic and hypnopompic states [109]. It is unknown if the theta waves before falling asleep [110] may be similar/dissimilar to the theta in KC's EEG. However, if one watches oneself as they are falling asleep (having one's arm in the vertical position, lying supine, and being aware of the nature of awareness/consciousness as one's arm falls as muscle flaccidity sets in [111] and one starts to drift off to sleep, one will notice that the "aperture" of consciousness seems to widen as the general "focus" of attention becomes more diffuse, until one loses consciousness (self-awareness) and drifts off to sleep (a procedure RP has done at times while falling asleep, to better discern the nature of awareness/attention during this transition to sleep).

The "unboundedness" that KC reports appears to be consistent with the increased theta during siddhi mediation, but without the delta activity ("sleepiness") that was evident during hypnosis. That tendency towards sleepiness, associated with the theta activity, may be partially "counterbalanced" by the left frontal high beta (associated with increase self-awareness and positive feelings, per the PCI). Hence, the long-term meditator is able to sustain theta without falling asleep, which may be like being on the "verge of sleep," but yet more alert and aware. The sustained theta would also be consistent with the change in body image from the PCI, some loss of volitional control, and the feelings of "expanded awareness" per KC, as if the "aperture" of awareness has been widened. The very high levels of self-awareness, concurrent with a change in bodily awareness and meaning (altered experience) and a subjective sense of an increasingly altered state of consciousness, as measured by the PCI, would be consistent with this.

There was little significant coherence in the alpha band for hypnosis. In contrast, there was much more significant frontal to posterior coherence in the alpha band for sidhi meditation. There was significant coherence for frontal to posterior regions for the theta band for hypnosis; meditation appears to have increased that theta coherence. Coherence can be considered a measure of functional connectivity [102] among the different modules of the brain, suggesting that sidhi meditation was associated with increased alpha and theta coherence versus hypnosis for this moderately hypnotically responsive individual. Ott [89] has suggested that increased phase synchronization of EEG activity across the whole cortex, especially gamma, will be associated with increasingly joyful, ecstatic, and "expansive" mystical experiences.

4.3 Limitations and Constraints

4.3.1 Demand Characteristics

The sidhi meditator reported in this study is also a psychologist and second author on this paper. Hence, he has read a great deal on hypnosis, and especially meditation. Although the qEEG results are much less likely to be due to demand characteristics [112]; the noetic results, because they are based on first person self reports, are more so likely to be so influenced. Future research will need to be conducted across groups of participants, who have little or no knowledge of the scientific basis of meditation and hypnosis, to better evaluate these preliminary, case study results.

On the other hand, the description concerning the "unboundedness" of sidhi meditation helps make the PCI/qEEG results more interpretable, which might not have been possible without the collaboration/discussion of KC's elaboration of his phenomenological experience of meditation, and his scientific knowledge of meditation and hypnosis.

4.3.2 The Possible Ineffability of Various Altered States of Consciousness

The state of consciousness of the meditator during sidhi meditation is hard to talk about or put into words, via-a-vis normal, everyday waking consciousness, per KC. The intense self-awareness without any internal dialogue for this advanced TM meditator would be an anomaly for most people, since such internal chatter would typically be associated with DMN (default mode network) activation [113] and mind-wandering or daydreaming. Deactivation of the DMN [114] is not addressed neurophysiologically in the current paper. It needs to be scrutinized in future noetic/neurophysiological research, as well as how neurophysiological connectivity issues [89, 115] may play a role in generating the particular state of consciousness associated with deep hypnosis or long-term meditation.

Tart [116, 117] suggested almost 50 years ago that it is the pattern of relationship ("connectivity") among the various "processors" that determine the particular state of consciousness that is activated, and not the activated intensity of those processors. There is conjecture that the nature of the meditational experience, especially when in "deep states of consciousness," such as with samadhi experiences [118], may be rather ineffable [118], and hence extremely difficult to put into words. Consequently, it can be asked as to how valid the PCI may be to accurately access/assess such "altered" states of consciousness?

The PCI is a third-generation questionnaire, developed from the first author's dissertation [17], and another iteration of an earlier version of the PCI [18]. Consequently, it is believed to "sample" several, but not all, of the major noema and noeses of consciousness [119, 120] that phenomenological psychologists [121] had postulated as defining the nature of subjective consciousness. (See Pekala, [18], for a review of this theorizing and development of the approach, which, in the past, has also been labeled, "psychophenomenology," Pekala, [122]) The PCI, and its associated methodology was developed to operationalize Tart's [116, 117] and Singer's (In Zinberg, [123]) theorizing on the nature and essence of altered states of consciousness.

A companion questionnaire, the Dimensions of Attention Questionnaire [36], was similarly developed to measure various facets of attention [124], since the PCI has only two subdimensions addressed to attentional experience. Numerous research studies by various researchers have attested to the usefulness of the PCI for assessing subjective experience associated with a variety of stimulus conditions, i.e., hypnosis, meditation, virtual reality, ictal consciousness, mediumship, psi phenomena, religious experiences, etc. (see the "Introduction").

However, the PCI has not been used with extremely altered states of awareness, as might be associated with the psychedelics [125], such as lysergic acid diethylamide [114, 126], ayahuasca [127, 128], psilocybin [129, 130] or dimethyltryptamine (DMT) [131, 132]. Here is where administering the PCI with questionnaires developed to specifically assess such altered psychedelic states [133], such as the Altered States of Consciousness Rating Scale (ver: 11D-ASC) [134], or the MEQ30 [135] may be especially useful [136]. Future research will need to continue to build upon the foundations laid here by the PCI, the 11D-ASC, the MEQ30, and others.

The brain/mind approach espoused in this paper may be especially useful when looking at the many variants of parapsychological phenomena [137, 138], psi phenomena and hypnosis [139, 140], anomalous experiences [141], and methodologies used to generate such experiences, such as the ganzfield [142]), to name only a few of the many areas of potential interest.

Additionally, various Buddhist texts talk about the increasingly "fine" levels of awareness achieved by long-term meditation, when looking at the domains of mindfulness and concentration [143]. Comparing the PCI, and also the DAQ, with meditational questionnaires [144-147] would also be useful, especially when looking at changes in attentional experience associated with different types of meditation.

As mentioned earlier, Facco et al. [33] have used hypnosis, the PCI, and the qEEG, to assess the nature of the out-of-the-body experience (OBE). This is an area where the PCI may be especially helpful in further understanding such experiences as documented by Buhlman [148, 149], Tressoldi et al. [150], and Ziewe [151, 152], especially if neurophysiology, as quantified by the qEEG or the fMRI, can also be concomitantly assessed.

4.3.3 Quantifying States of Consciousness via Pattern Effects

If there were a large enough group of meditators/hypnotic participants involved in the research as a function of stimulus condition, a psygram (a graph of the psychophenomenological state of consciousness of the group of participants experiencing that stimulus condition) could be constructed to show the patterns of relationship among the various PCI dimensions [122]. Significant pattern/connectivity differences were found among PCI dimensions between low and high suggestible individuals during hypnosis versus a baseline, eyes closed sitting quietly condition [43, 44, 153]. Such differences were replicated by Cleveland, Korman, and Gold [154].

Hence, besides looking at variations in intensities among the 12 PCI dimensions via radar graphs or pips (phenomenological intensity profiles – see Figure 5), the researcher can visually diagram and statistically assess the strength of the patterns of association [155, 156] among such dimensions via psygrams. This would hence allow for the state of consciousness, as theorized by Tart [116, 117], to be quantified and visually diagrammed for the different conditions/groups of participants [18]. Rock and associates [66, 157] have been using psygram theorizing and analysis rather extensively in their research on altered states of consciousness.

4.3.4 Conjectures Based on an *n* of One

A major concern with the aforementioned theorizing is the fact that the authors are making conjectures between the qEEG and what has been reported on the PCI/PCI-HAP using an *n* of 1. Such “case study” conjectures, although supporting interesting hypotheses between mind and brain, are just that: conjectures. The case study research reported herein, needs to be supplemented with research conducted across groups of participants, and compared against controlled conditions, to better determine the nature of the brain/mind relationships. The study by Thomas et al. [85] is an excellent example of such controlled research.

4.3.5 The Complexity of the Task Involved in Assessing Neurophysiological Data

As mentioned earlier, Landry, Lifshitz and Raz [82] in their comprehensive and sophisticated “systematic and meta-analytic” review of neuroimaging studies of hypnosis, concluded that *“there remains little consensus concerning the neural mechanisms and a great deal of inconsistence among findings”* (p. 92). Instead of finding that the central executive network (CEN), the salience network (SN), and the default mode network (DMN) were main contributors in parsing out the variance associated with hypnotic responsibility, their sophisticated analyses, employing activation likelihood estimates (ALE), implicated the lingual gyrus and visual processing mental imagery "as the sole reliable neural pattern relative to the current body of neuroimaging findings" (p. 91).

Interestingly, the importance of imagery (amount and vividness) was found to account for about 28% of the relative variance (as assessed by standardized coefficients) in predicting the hypnotic responsivity index (HRI) score of about 100 Italian participants who completed the PCI-HAP [55]. Two earlier studies [158, 159] also implicated the importance of imagery, and its relationship to imagery vividness before and during a hypnotic induction, in better understanding hypnotic responsivity as noetically assessed by the PCI-HAP. Hence, use of the PCI-HAP in better determining the neurophenomenology of hypnosis and hypnotic responsivity, appears warranted.

Palmiero and Piccardi [160], in their "mini-review" of frontal EEG asymmetry and mood, concluded that regardless of the *"research line considered, there are contrasting results that cannot be unequivocally interpreted according to one frontal asymmetry model rather than another"* (p. 5). The complexity of the task of mapping the brain are mind-boggling.

About ten years ago, Baars and Gage [161] reported there to be about 100 Brodmann areas, suggesting that this may be taken as a general estimate concerning the number of specialized areas of the cortex. Additionally, there are about 100 billion neurons of the human brain and about 1000 synaptic connections per the average neuron [162]. This means that there are trillions of connections amongst these 100 billion neurons. In summary, the brain is the "most complex object in the known universe" [162]. Is it no wonder that different laboratories employing somewhat different methodological procedures lead to conflicting results, given the astronomical number of resulting permutations that may be induced by slight changes in the stimulus set/instructions?

Psychophysiological isomorphism [31] posits *"a one-to-one correspondence between mind and brain states"* ([31], p. 222). Close to 40 years ago the first author [163] posited the principle of "stimulus-state specificity," as a means to relate quantifiable phenomenological (mental) experiences with their corresponding behavioral and stimulus settings/environments. This principle posited that different stimulus environments (when assessed across groups of randomly chosen participants), which includes all instructional sets and associated environmental/behavior cues, will be associated with different intensities and/or patterns of noetic (phenomenological) experiences, while the same stimulus environments will be associated with nonsignificantly different intensities and patterns of noetic (phenomenological) experiences.

Combining these two principles means that changes in the stimulus setting (instructional and environmental set), will lead to activation of the different modules (and their associated connectivities) in the brain, which, in turn, will reflect subtle changes in neurophysiology and hence corresponding changes in the qualia experienced by the participant. So, even changing the instructional set slightly concerning what participants are to do, will likely affect not only the neurophysiology, but also the noetics of what will be experienced. In practical terms, the instructional sets and the stimulus settings may have significant impact on neurophysiology and its corresponding noetic enactment. So near identical studies with slightly different instructional sets, may lead to somewhat different noetic/neurophysiological involvement.

4.3.6 The Reliability and Validly of First Person Self-Reports

Davidson and Kasznik [164] talk about the myriad of conceptual and methodological issues that need to be resolved in better researching the mind, mindfulness, and meditation. They specifically address the rationale popularized by Varela and colleagues [165, 166], a view that the current authors believe is mistaken: *"that reports of conscious experience derived from minds that have not had this form of [meditation] training will be tainted by distraction and thus be compromised with respect to both reliability and validity"* (p. 585).

Neurophenomenology, as defined by Lutz and Thomson [27] uses "first-person methods," which they deem to be well rehearsed subjective practices that participants can use to "fine tune" their sensitivity towards, and articulation of, their ongoing subjective experiences. This training involves the self-monitoring and regulation of attention, emotion and consciousness, in such a manner to give the participant more accurate awareness and perception of the fleeting and evanescent nature of conscious experience, so as to more fully ascertain the nature, and quality, of that experience.

On the contrary, we believe that such "training" establishes subtle stimulus expectancies and biases into the nature of introspection, which may subsequently influence the qualia of that phenomenological experience. The aforementioned argument is not new, as historians of classical introspection will attest. Such trained introspection was used by the classical introspectionists over 100 years ago, and this approach was "buried" by Watson's classic rebuttal of introspectionism: "Psychology as the behaviorist views it" [167]. The results, as summarized by Boring [14], suggested that different laboratories will train introspectionists in slightly, and subtly, different ways. The result were differences in the qualia reported by various introspectionists across different laboratories, and the *"consciousness of action, feeling, choice, and judgment"* (p. 176) were neither reliable nor valid.

Noetic analysis, on the other hand, uses "untrained" introspectionists, i.e., individuals with no specific training in introspection. Such training is not necessarily due to the fact that participants retrospectively quantify their subjective experience via standardized (self-report) questionnaires in reference to short periods of time. (See Pekala, [18], for a more thorough review of the "pros and cons" for and against the use of retrospective first person self-reports with standardized inventories.) Additionally, a search of the term, "Phenomenology of Consciousness Inventory (PCI)," with google will reveal scores of articles on the reliable and valid use of the PCI to map states of consciousness, and the noetic experiences associated with a myriad of stimulus conditions.

4.3.7 Assessment Length and Order Effects

The sitting quietly period during the PCI-HAP was 5 minutes, whereas the sidhi meditation period was 10 minutes. It was felt that 10 minutes were needed for the effects of the sidhi mediation to be fully discernable. The usual period for the PCI-HAP sitting quietly period is 3 minutes [93]. Because the typical sitting quietly time period was shorter than the 10 minutes for the sidhi mediation, this sitting quietly period during the PCI-HAP was increased to 5 minutes for the present study. Future research will need to have equivalent periods of time for both hypnosis and meditation conditions. Order effects were also not addressed, and may have had some impact on the results.

5. Conclusions

Lifshitz [25] said several years ago that *"whereas scientists have access to a plethora of advanced methods for investigating brain and behavior, they face a dearth of techniques for the empirical analysis of phenomenology"* ([26], p. 9). Noetic analysis [16, 21] provides a reliable and valid methodology to not only quantify and statistically analyze phenomenological experience, but provides a means to assess and diagram states and altered states of consciousness [116, 117] associated therewith [168]. When combined with the qEEG, noetics may be especially helpful in better understanding not only consciousness and states of consciousness, but the various processes associated therewith, including emotional regulation, decision making, psychopathology, and their influence upon mental health and individual differences factors [169].

Based on the aforementioned discussion, the reader can understand how combining the qEEG with the PCI allows for the qualia associated with the aforementioned qEEG frequency, asymmetry, and coherence results, to be compared and contrasted. The results may be even more interesting when combining noetics with sLORETA [170], and the host of other neurophysiological methodologies, such as the fMRI (functional magnetic resonance imaging) as Modestino [34] has done. By quantifying the qualia of mental experience, we believe it will be easier to generate quantitative hypotheses concerning the mind/brain interface associated with that experience. Its use across groups of participants with different stimulus conditions is an important next step.

Combining the PCI with the qEEG allows for subjective referents associated with neurophysiology to be quantified and statistically evaluated during hypnosis, meditation, and possibly other altered states of consciousness [171]. Evaluating the brain with the qEEG during meditation or hypnosis, while neglecting the qualia [23] associated therewith, is like measuring the neurophysiological parameters of the orgasm, but ignoring the nuances of the subjective experience of its associated ecstasy [172]. Several different levels of analysis are needed for a more complete understanding of the phenomenon of interest.

Use of this approach to better quantify the brain/mind interface across groups of low and high hypnotically responsive participants during hypnosis and meditation, may be especially helpful in allowing for a more rigorous mapping of the brain/mind continuum than is currently available. Paraphrasing Jamieson and Jensen et al., we believe that in trying to better unravel the *"bewildering array of practices [of meditation and hypnosis] across different cultural settings and in different historical epochs"* ([5], p. 313) such investigations *"are probably best explained by more comprehensive models that take into account factors from biological, **noetic** [our italics/addition], psychological and social domains"* ([7], p. 63).

Phenomenological experience needs to be comprehensively quantified [25, 27, 28] as an important, but equal, domain in being able to truly decipher the mystery of altered states of consciousness [109] and their many and varying, associated qualia. Almost 30 years ago the first author suggested that

> *the next revolution in psychology, mental health, and cognitive science... will be a noetic-behavioral one from both a research and an applied perspective... by showing that noetic aspects of human experience can be quantified and statistically assessed in a comprehensively reliable and valid manner... Only an approach that considers both man's objective and subjective environments, his world and his psyche... will be able to do justice to that complexity we call human* ([18], p. 350).

Hopefully, the present case study suggests the usefulness of such an approach. Future research appears warranted.

Footnotes

This paper does not represent the views of the United States Government nor the Department of Veterans Affairs. Requests for reprints should be sent to: Ronald J. Pekala, Ph.D., 309 North Franklin St., West Chester, PA 19380-2765; ronald.pekala@gmail.com. The authors wish to thank Daniel Kaufmann, Ph.D., for his helpful comments on an earlier version of this manuscript.

[1]Copies of the PCI [29], and the user's manual and EXCEL scoring protocols for the PCI [173] are available at www.quantifyingconsciousness.com. Copies of the PCI-HAP [71, 72], the self-report and therapist versions of the pre- and post-assessment forms, the administration manual [93], the interpretative manual [101], and the EXCEL scoring protocol for the PCI-HAP [174] are also available at www.quantifyingconsciousness.com. [Please note: while anyone can download and procure a copy of the PCI and its EXCEL scoring sheet; you must be a clinician or researcher with validated experience in hypnosis to procure the PCI-HAP.]

[2]Gamma activation - 25 to 42 Hertz - for Thomas et al.'s study was defined to include "high" beta - 26 to 30 hertz – as assessed in the present study. Hence the present study's "high" beta activation, can be considered a part of Thomas et al.'s gamma activation.

Authors Contributions

This paper is based on numerous conversations between the authors concerning the nature of hypnosis, but especially meditation, for whom the second author is the "practicing" phenomenological expert. The first author designed and conducted the study, and wrote the paper. The second author was involved in "fine tuning" the results and discussion sections of the paper.

Competing Interests

The authors declare that there are no competing interests.

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