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Research

The Consciousness State of Traditional Nidrâ Yoga/Modern Yoga Nidra: Phenomenological Characterization and Preliminary Insights from an EEG Study

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Abstract

Nidrâ yoga is an ancient yogic practice capable of inducing altered states of consciousness characterized by deep relaxation, strong concentration, acute self-awareness, and joy. In modern contemplative neuroscience language, it is known by the name *yoga nidra,* and few studies have investigated its phenomenological and psychophysiological effects. Six healthy volunteers (four females aged 31–74) performed 12 yoga nidra sessions guided by an expert during a 6-day retreat. Each session consisted of 10 minutes in a resting state (baseline) followed by 2 hours of yoga nidra. Psychometric data regarding dissociative experiences (Clinician Administered Dissociative States Scale) and the state of consciousness (Phenomenology of Consciousness Inventory) were collected after baseline and yoga nidra, while high-density EEG was recorded during the entire session. During nidra sessions, no sleep hallmarks (i.e., K-complexes and sleep spindles) were detected by the EEG in any subject. Psychometric data were analyzed using a Wilcoxon signed-rank test corrected with the false discovery rate approach for multiple comparisons. Compared to baseline, yoga nidra practice was related to: (1) increased dissociative effects (p = 0.022); (2) perception of being in an altered state of consciousness (p = 0.026); (3) alterations in perceived body image (p = 0.022); (4) increased "meaningfulness" attributed to the experience (p = 0.026); (5) reduced rational thinking (p = 0.029); and (6) reduced volitional thought control (p = 0.026). First-person experience is discussed in relation to descriptive EEG power spectral density analysis, which was performed in one subject because of severe EEG artifacts in the other recordings; that subject showed, compared to baseline: (1) early increase of alpha and beta power, followed by a progressive widespread reduction; (2) widespread early increase of theta power, followed by a progressive reduction; and (3) widespread increase of gamma power in the latest stages. The present preliminary results enrich the knowledge of yoga nidra, elucidating its phenomenology and suggesting some psychophysiological correlates that future studies may address. *Zaccaro et al. Int J Yoga Therapy 2021(31). doi: 10.17761/2021-D-20-00014.*

Keywords: yoga nidra, consciousness, meditation, phenomenology, psychophysiology, electroencephalogram (EEG)

Introduction

Nidrâ yoga is an ancient Indian practice capable of inducing altered states of consciousness characterized by strong concentration, acute self-awareness, and joy, as well as by deep relaxation similar to sleep. The word *nidrâ* is a Sanskrit term that took on different meanings over the centuries. According to Macdonell,[1] the word is composed of *ni* + *drā* and means "to sleep." The preverb *ni* indicates "down," "back," or "into"; always prefixed to either verbs or nouns, it has also the meaning of negation or privation. Importantly, *ni* should not be confused with *nī* (as in the word *nīca*), which means "low" or "deep" and is commonly proposed as a possible translation.

In the traditional Indian context, nidra means "sleep," but it designates a form of sleep different from *svapna* (sleep with dreams) or *sushupti* (deep sleep). Traditionally

speaking, nidra is not really sleep, but it corresponds to the "sleep of the god Vishnu," which metaphorically designates the state of the universe between two deployments (i.e., the universe in its phase before the big bang, a state in which the future universe is in the form of potentiality yet unmanifested).[2] In this perspective, *ni* indicates pure negation because this state cannot even be considered "empty"—it is negative compared to a state of positive manifestation. Traditionally, this kind of void is called "absolute night."[3] Moreover, as Williams[4] indicates, *drā* contains the notion *(drāyati-drāti)* of "to fall asleep," indicating a movement. The full root *drā* means "to run" or "make haste," which in the Indian spiritual framework indicates the movement of the flow of energies.[4] When applied to sleep, this root indicates an inward movement, the movement that drives into the meditative state. Nidra is therefore both a movement of energies and the place where these energies are stored and perfectly inactive, a place of nonbeing designated as absolute night. It therefore seems appropriate to denote the movement that leads to this state of nonexistence by the poetic translation of "crossing the night" or "moving through darkness." This indicates the exploratory nature of the practice into the hidden parts of human consciousness and its aim of exploring the effects on the mind of "pure consciousness," which traditionally is said not to be directly understandable.

As Sanskrit language evolved over time, nidra took on different meanings such as "budding," then the "creative state of gods" creating the worlds, and lately simply "sleep." Within the scientific literature, at present yoga nidra is intended as the ability to gain awareness of presleep stages (e.g., hypnagogic state), retaining consciousness of both inner and outer worlds without falling asleep. Nidra tradition stems mainly from Hindu spirituality[5,6] and from Mahayana and Vajrayana Buddhism,[7] but scant scriptures characterize the practice. At present, a clear definition of yoga nidra is still lacking, as is a distinction between the formal practice of nidra and the nidra state itself[7]: This problem also has to be faced when dealing with other meditation practices (in particular with "mindfulness"[8]). Moreover, the term *nidrâ yoga* is not commonly used by the scientific community, and it has been (sometimes improperly) replaced by the more recent *yoga nidra.* For consistency with the scientific literature, the latter is used in the remainder of this article.

Unlike other yoga traditions involving different positions *(asana),* yoga nidra is mainly performed lying in the supine position *(savasana),* keeping the eyes closed and paying attention to the teacher's verbal instruction.[6] A "modernized" version of yoga nidra was popularized by Satyananda Saraswati, from the Bihar School of Yoga.[9] This perspective divides nidra practice into five phases: (1) setting a specific intention; (2) external rotation of consciousness, similar to a body scan, during which the meditator moves the attention to specific parts of the body; (3) internal rotation of consciousness, during which the meditator focuses the attention on subtle energy flows, such as nadis and chakras; (4) breath awareness and breath counting; and (5) guided visual imagery.

In the Yoga Sadhana, the nidra state is characterized by four different intensities, which bring different types of experiences. These teachings belong to the corpus of the Shaiva tradition and had been kept secret among ascetic lineages for centuries; only relatively recently have they emerged. Nidra states are described as linking two different states of the mind, such as linking the waking and dreaming states, the dreaming and deep-sleep states, and the deep-sleep and waking states. A fourth state, called *turiya* in Sanskrit, is described, where the ordinary separation between the perceiver and the perceived, the subject and the object, has vanished, giving birth to a state of endless sensitivity, unity, and intense joy.

In the current scientific literature, the nidra state of consciousness is described as an altered (or nonordinary) state similar to a conscious hypnagogic state, which is neither sleep nor wakefulness,[10] during which the meditator is vigilant but maintains a decentered attitude (i.e., without attachment) toward their own mental contents, sustaining pure "witnessing awareness."[6] However, there are some stages preliminary to the nidra state. Swami Veda Bharati has proposed a model comprised of four stages, putatively identifiable by different neurophysiological markers[7,11]:

- Stage 1 is characterized by a deeply relaxed state with parasympathetic dominance, and it is identifiable by alpha and theta electroencephalogram (EEG) power increase.
- Stage 2 is marked by an aware hypnagogic state characterized by increased visual imagery and creativity, and it is identifiable by theta and delta EEG power increase.
- Stage 3 is a deep state similar to non-REM sleep but with maintenance of surrounding awareness, putatively identifiable by correct verbal report during delta-wave predominance.
- Eventually, nidra culminates in stage 4, characterized by the dissolution of all conscious contents (sensory, thinking, or intentional) and the experience of nothing but pure awareness, which corresponds to turiya or the Buddhist "clear light"[7,11] and to contemplative neurosciences terms such as "pure consciousness" and "nondual awareness."[12,13]

Scientific literature on the psychophysiological basis of yoga nidra is limited and generally lacks methodological quality, making it impossible to draw firm conclusions. Many studies have been published in non–peer reviewed journals, and most published studies are mainly anecdotal; raw data are rarely available. However, there are some exceptions: A positron emission tomography (PET–EEG) study performed in 1999 robustly investigated the nidra state.[14] The authors enrolled nine yoga teachers with several years of teaching experience, and compared to a baseline resting state, they detected during yoga nidra increased metabolism in parietal and occipital cortices and in the hippocampus, together with decreased metabolism in a number of subcortical and cortical areas, including caudate, thalamus, pons, cerebellum, and dorsolateral, orbitofrontal, anterior cingulate, temporal, and inferior parietal cortices. The main EEG outcome was a widespread significant increase of theta power. Interestingly, at the first-person level, meditators reported a common experience of emotional and volitional detachment, self-reporting a distinct lack of volitional activity and reduced control over their contents of consciousness.[14] Moreover, a related PET study on eight experienced teachers, using radioactive 11C-raclopride, evidenced a 65% increase in dopamine release during yoga nidra, associated with decreased striatal activity and reduced executive control and attentional engagement.[15] Finally, a 2017 study investigated EEG correlates of a yoga nidra–related practice from the Himalayan tradition, which includes deep relaxation, breath awareness, diaphragmatic breathing, mantra recitation, and focusing on chakras (performed in a supine position): The authors found increased parietoccipital EEG gamma power, as well as decreased alpha power during the practice, compared to a control condition. At the first-person level, meditators self-reported a deep state of meditation with low thought density.[16]

The present study investigated conscious experience during yoga nidra and its electrophysiological correlates. The motivation of the present study was to: (1) adopt a stage-related approach to highlight differences in EEG activity reflecting different effects of each meditation stage; and (2) use a valid and reliable psychometric tool to evaluate first-person (phenomenological) experiences and their variations during the practice.

We adopted an integrated phenomenological and electrophysiological approach and discuss results relying on current contemplative neuroscience literature[17] as well as on yoga nidra tradition.

Methods

Overview

Six healthy volunteers (4 females and 2 males, aged 31–74 years) were recruited for the study. All subjects had long-term formal yoga nidra practice estimated between 10 and 12 years. Each session consisted of a 10-minute baseline resting state (baseline) and a subsequent 2-hour group yoga nidra session.

Finding competent participants is always a serious issue in attempting to study the nidra state. For this reason, the study was conducted on high-level yoga practitioners with many years of experience and included a total of 12 yoga nidra sessions to increase the power of the study. Nidra sessions were guided by André Riehl, a yoga practitioner with decades of worldwide study and nidra teaching experience. A yoga retreat setting was chosen, as it was the only possibility to test a group of yoga experts guided by an expert teacher at the same time. We chose to recruit expert practitioners because selecting both meditators and teachers from the nidra tradition is crucial for studying it empirically.

On the contrary, in the study of Lou et al.[14] participants performed the practice by following a running tape for 45 minutes, with a voice guiding the meditation through different stages. This was an important limit of the research, as the relationship with the teacher is a determinant for the meditation experience itself. In addition, Braboszcz et al.[16] did not directly investigate yoga nidra, but rather the related practice of Himalayan Yoga, which consists of many steps, of which only one is called yoga nidra, a deep relaxation technique performed in corpse position. They recruited Himalayan Yoga expert meditators, and there was no yoga nidra teacher to guide the session.

All sessions in the present study were conducted in a quiet room during a 6-day retreat at Somapa, a yoga center in Eyragues, France. During baseline, subjects were simply lying in a supine position, breathing spontaneously with eyes closed. Yoga nidra sessions are not monolithic, as they develop through different stages, each of which has its own specific neurophysiological correlates. However, at the EEG level, both the study from Lou et al.[14] and Braboszcz et al.[16] have important limitations with respect to a stage-based approach. In the study of Lou et al.[14] the protocol showed notable differences from Satyananda Saraswati's yoga nidra stage definitions, comprising verbal guidance to experience the weight of individual body parts, to experience joy and happiness in abstract form, to visually imagine various landscapes, and to the abstract perception of the Self. In addition, Braboszcz et al.[16] investigated short yoga nidra sessions lasting 10 minutes each, making it impossible to study different stages of meditation.

In the present study yoga nidra sessions were divided into four different stages:

1. relaxation/body scan, comprising *sithilikarana* (a deep relaxation within three progressive levels leading to a state of complete surrender) and "organ

recitation" (focusing the attention on a specific part of the body and voluntarily relaxing it), for a total of 40 minutes;

2. nidra 1, comprising mental visualizations of different images and *svadhyaya* (an inquiry into the processes of the mind, using particular language methodology for shifting from the logical mind to different states of intense sensitivity), for a total of 30 minutes;
3. nidra 2, comprising svadhyaya and *dharana* (an intense concentration developing through three progressive degrees and ending in a state of total presence), for a total of 30 minutes; and
4. open awareness, in which subjects become aware of every sensation with a witnessing awareness attitude for a total of 20 minutes, until the end of the practice.

All subjects signed an informed consent form; the study was approved by the local ethical committee and adhered to the tenets of the 1964 Declaration of Helsinki and its later amendments.

Psychometric Questionnaires

To our knowledge, no previous study has adopted valid and reliable psychometric tools that allow for a phenomenological inquiry of the state of consciousness elicited during nidra practice. Lou et al.[14] administered ad hoc (nonvalidated) questions to investigate volitional control over the contents of consciousness, while Braboszcz et al.[16] used ad hoc questions related to meditation depth and thought density, as well as items extracted from the "relaxation" and "hindrance" subscales of the Meditation Depth Questionnaire.[18]

To overcome these limitations, we chose the Phenomenology of Consciousness Inventory (PCI), a 53-item self-administered questionnaire completed after exposure to a particular condition and in reference to it. The tool follows an empirical-phenomenological approach, a retrospective assessment that aims to move beyond descriptive phenomenology to a quantitative approach to the mind that statistically evaluates variations of phenomenological contents of consciousness. The PCI was originally developed to measure hypnotic responsivity,[19,20] but it was also used to assess phenomenology of different nonordinary states such as slow breathing-related conditions,[21,22] holotropic breathwork,[23] Zen meditation,[24] out-of-body experiences,[25] and the Ganzfeld illusion.[26]

Two questionnaires—the Clinician-Administered Dissociative States Scale (CADSS)[27] and the PCI—were administered at the end of the baseline (immediately before the beginning of the yoga nidra session) and immediately after the end of the session:

The CADSS[27] is a tool designed to investigate dissociative states experienced in the present, such as out-of-body experiences, distorted perceptions of the body, distortions of visual perception, and alterations of the sense of self. The CADSS is a 27-item scale, of which 8 items are clinician-administered and 19 are subject-rated. Based on previous research,[28] we adopted only the self-administered version of the questionnaire. For each subjective item, the subject is asked to answer a question referred to "this precise moment." The answer is based on a Likert scale from 0 to 4, and the subject selects a response based on the degree of agreement with the item (from *not at all* to *extremely*).

The PCI is a self-administered, retrospective questionnaire allowing a phenomenological quantification of subjective conscious experience. The PCI stems from Ronald Pekala's operationalization of consciousness.[19] The questionnaire has to be completed in reference to a previously experienced situation, preferably within 20 minutes of the event. It comprises 12 major dimensions and 14 subdimensions and a total of 53 items. The major dimensions are

1. altered state (subjective feeling of being in an unusual state of consciousness);
2. altered experience (alterations of specific aspects of perception, four subdimensions: body image [changed perception of the body]; time sense [changed perception of time flow]; perception [changed perception of the world]; and meaning [unusual or sacred meaning attributed to the lived experience]);
3. volitional control (feeling of control over consciousness contents, e.g., thoughts or images);
4. self-awareness (degree of consciousness of the self);
5. rationality (lucidity and rationality of thoughts);
6. internal dialogue (degree of verbal thoughts);
7. positive affect (positive experienced emotions, three subdimensions: joy, sexual excitement, and love);
8. negative affect (negative experienced emotions, three subdimensions: anger, fear, and sadness);
9. mental imagery (the quantity and quality of eyes-closed imagery, two subdimensions: imagery amount and imagery vividness);
10. attention (changes of the attentional level, two subdimensions: direction of attention [inner- or outer-directed attention] and absorption [absorption in the experience]);

11. memory (how much the subject is able to remember the experience); and
12. arousal (feeling of physical and psychological tension).

Each item consists of two sentences of opposite meaning, separated by a 7-point Likert scale (from 0 to 6).

EEG Recordings and Preprocessing

High-density EEG was recorded during each experimental session. EEG recordings were carried out using a Net Amps 300 system (GES300), and signals were acquired at a 500-Hz sampling rate using Net Station software (v. 4.4.2). EEG signals were recorded using a 128-electrode HydroGel Geodesic Sensor Net (Electrical Geodesic, Inc.). EEG channels were referenced to the vertex, keeping impedance values below 50 kΩ.

EEG recordings were divided into five time segments corresponding to baseline and to the stages of the yoga nidra session (relaxation/body scan, nidra 1, nidra 2, and open awareness). To reduce the heterogeneity of the EEG signals due to different durations of each abovementioned stage, 5-minute artifact-free epochs were extracted from the final parts of the baseline and each yoga nidra stage. We chose to analyze the power spectrum of 5-minute time windows (after artifact removal), one for each stage, to measure as much as possible the effect induced in that stage. Selecting longer time windows (e.g., 10 or 20 minutes) would have caused the loss of time information, and more epochs would have made the data unreadable. Time windows were located toward the end of each stage, where it is reasonable to assume that the correlates of that stage are more developed and therefore more detectable by the EEG.

EEG signals were analyzed for each subject using tailored codes written in Matlab (MathWorks) and EEGLAB (v. 14.1.1) functions.[29] EEG signals were downsampled to 250 Hz, high-pass filtered at 0.1 Hz (Chebyshev II filter), and notch filtered at 50 Hz and its first harmonic (100 Hz). Channels located on the forehead and cheeks, which mostly contribute to movement-related noise, were discarded.[30] Epochs with EEG signals exceeding 100 μV were automatically discarded; retained signals were visually inspected for the removal of artifacts and noisy channels. Rejected signals were substituted with signals obtained via spline interpolation.[31] Retained epochs of each stage (baseline, relaxation/body scan, nidra 1, nidra 2, and open awareness) were concatenated and submitted to an independent component analysis to remove ocular and/or muscular artifacts.[32] Signals were finally re-referenced to the mastoids' average.[33] Unfortunately, due to the presence of massive movements and muscle artifacts in the EEG recordings of five subjects, we finalized EEG analysis in a single participant. However, in the discarded recordings we were able to visually assess the absence of sleep hallmarks (non-REM N2 features, e.g., K-complexes and sleep spindles).

Data Analysis and Statistics

For the total score of the CADSS and for each psychometric subscale of the PCI, differences between the baseline and the yoga nidra sessions were assessed using paired Wilcoxon signed-rank tests. *p* Values were corrected using the false discovery rate (FDR) approach for multiple tests,[34] and the significance threshold was set at $p < 0.05$. Effect-size values *(r)* were also calculated by dividing the *z* score of each comparison by the square root of the total number of pairwise comparisons.

Regarding the EEG data, a spectral analysis was conducted for each experimental stage (baseline, relaxation/body scan, nidra 1, nidra 2, and open awareness) in one subject (N006). For each stage, the mean power spectrum density (PSD) of each channel was evaluated by applying a Hamming-windowed fast Fourier transform on 2-s consecutive epochs and averaging between them. PSD was evaluated for five bands of interest: delta (1–4 Hz), theta (4–8 Hz), alpha (8–12 Hz), beta (12–30 Hz), and gamma (30–45 Hz). For each band, the power density was obtained by averaging among the bins pertaining to the band and log-transforming the mean value. Comparisons between each stage of the yoga nidra session and the baseline were assessed for each band and electrode by normalizing transformed powers of each stage to their respective log-transformed values of the baseline (i.e., ratio between relaxation/body scan and baseline, nidra 1 and baseline, nidra 2 and baseline, and open awareness and baseline).

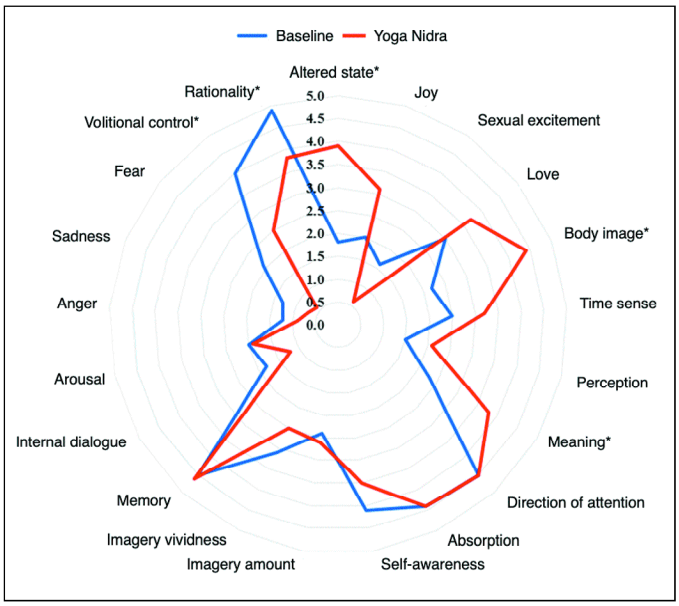
Finally, we wanted to assess whether the self-report scores of subject N006 were typical compared to the group, which would allow us to draw connections between that subject's EEG activity and that of the other participants. To this end, we compared the N006 participant's PCI scores to the mean scores of the group based on the examination of vertical boxplots related to each PCI subscale.

Results

Psychometric Questionnaires

A total of 12 yoga nidra sessions performed by six expert yoga practitioners were analyzed. After yoga nidra (compared to baseline), subjects coherently reported a higher CADSS score associated with increased dissociative effects, such as sensations of distorted perception of the body, distortions of visual perception, and alterations of the sense of self (corrected $p = 0.022$, $r = 0.885$). Regarding PCI, after yoga nidra (compared to baseline), participants reported: (1) increased perception of being in an altered state of

Figure 1. Radar Graph of the Yoga Nidra State of Consciousness Compared to Baseline, as Assessed by Scores of Each PCI Subscale



* = Wilcoxon signed-rank test, false discovery rate–corrected $p < 0.05$.
PCI = Phenomenology of Consciousness Inventory.

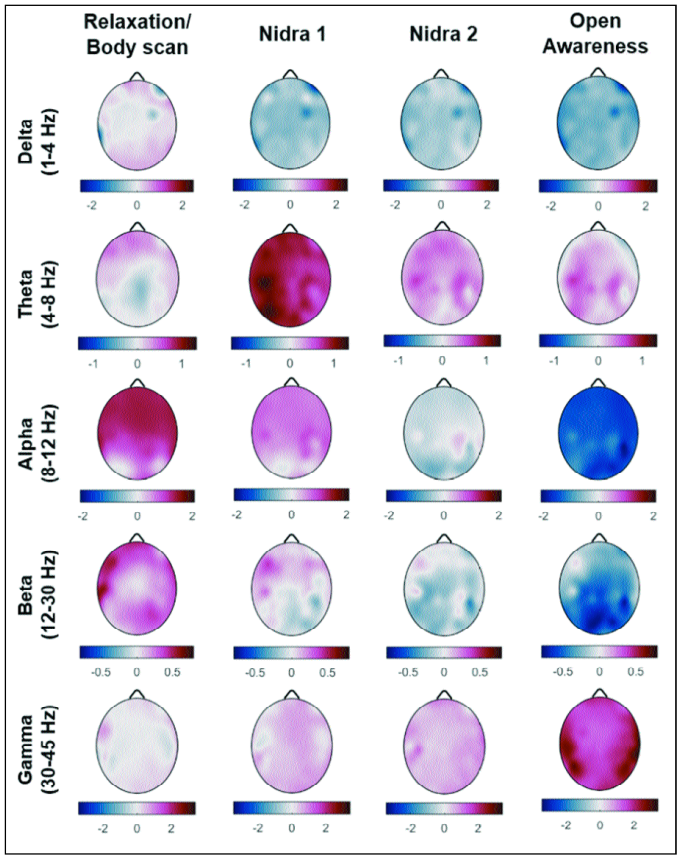
consciousness (corrected $p = 0.026$, $r = 0.838$); (2) alteration of body image, perceived bodily expansion, and loss of physical boundaries (corrected $p = 0.022$, $r = 0.884$); (3) increased sacred meanings attributed to the experience (corrected $p = 0.026$, $r = 0.793$); (4) reduced rational thinking (corrected $p = 0.029$, $r = 0.76$); and (5) reduced volitional thought control (corrected $p = 0.026$, $r = 0.81$). Effect sizes were large for all significant outcomes. Moreover, we found two statistical trends that did not survive the FDR correction for multiple comparison: (1) increased perceived joy (uncorrected $p = 0.059$, $r = 0.544$), and (2) reduced perceived fear (uncorrected $p = 0.025$, $r = 0.648$) (Supplementary Table 1). A radar graph of the nidra state of consciousness is presented in Figure 1.

Neurophysiological Correlates

At the EEG level, no signs of sleep (i.e., non-REM N2 signs such as sleep spindles and K-complexes) were detected for any of the participants. In the descriptive PSD analysis related to a single subject (N006), comparisons with baseline revealed:

- widespread increase of alpha and beta PSD during relaxation/body scan, followed by a progressive decrease until open awareness;
- higher widespread theta PSD during nidra 1, compared to the other stages;
- higher widespread gamma PSD during open awareness compared to the other stages; and
- no change in delta-band PSD.

Figure 2. Power Spectral Density (in Decibels) of Each Yoga Nidra Stage, Normalized to the Baseline[a]



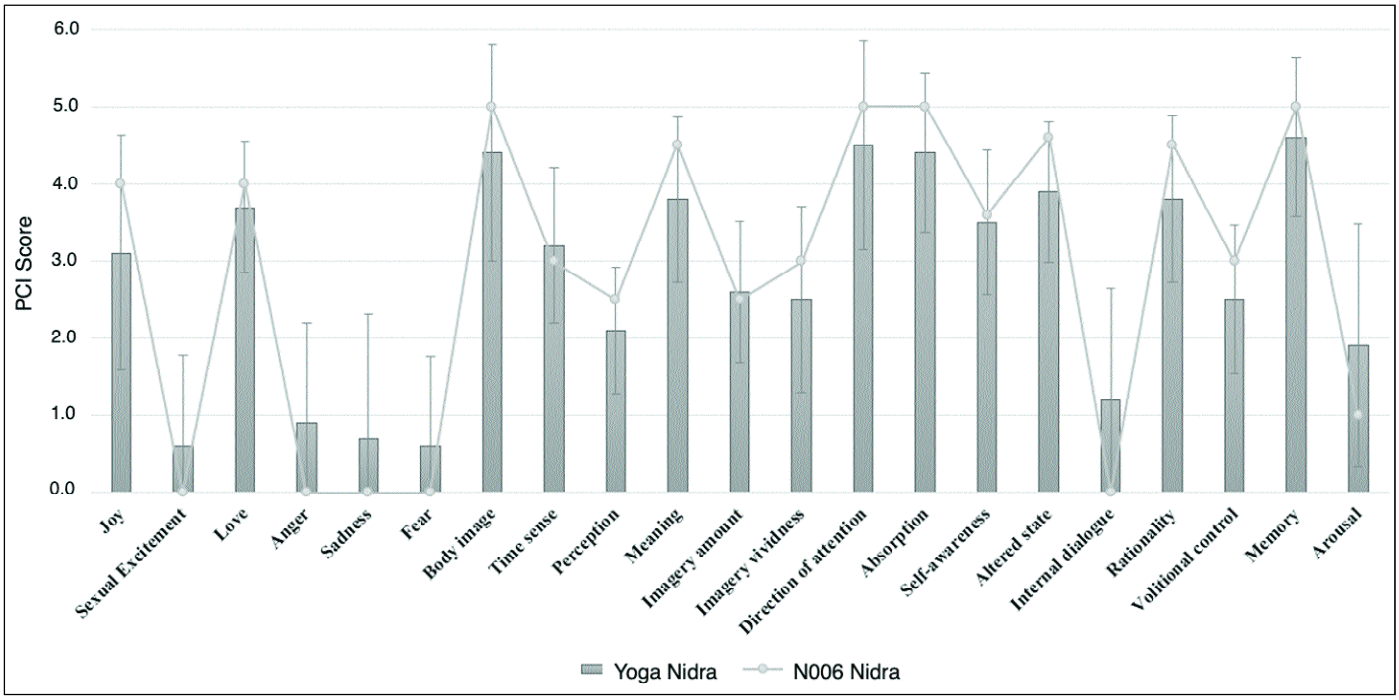
[a]For each stage, log-transformed powers of each electrode and band were normalized to their respective log-transformed values of the baseline (ratio between each stage and the baseline). Limits of the color scale represent the minimum and maximum power values calculated in every stage for each band.

Band-wise comparisons between yoga nidra stages and baseline are shown in Figure 2.

Subject N006 First-Person Experience

Normalized PCI self-reports scores of subject N006 were as follows: joy (4.0), sexual excitement (0.0), love (4.0), anger (0.0), sadness (0.0), fear (0.0), body image (5.0), time sense (3.0), perception (2.5), meaning (4.5), imagery amount (2.5), imagery vividness (3.0), direction of attention (5.0), absorption (5.0), self-awareness (3.6), altered state of awareness (4.6), internal dialogue (0.0), rationality (4.5), volitional control (3.0), memory (5.0), and arousal (1.0). We compared N006 scores to the mean scores of the group, based on the examination of vertical SPSS boxplots for each PCI subscale. In SPSS boxplots, the length of the box is the interquartile range, while the median is a line inside the boxplot; values of more than 1.5 interquartile ranges are considered outliers, indicating a significant departure from the group mean. None of the PCI subscale scores was an outlier, supporting this subject's representativeness with respect to the group (data not shown). N006's PCI score is

Figure 3. Yoga Nidra State of Consciousness of Subject N006, as Assessed by Scores of Each PCI Subscale, Compared to the Yoga Nidra Group Mean Scores and Standard Deviations for Each PCI Subscale



PCI = Phenomenology of Consciousness Inventory.

presented in Figure 3, comparing it to the group mean score and standard deviation after yoga nidra sessions. In addition, Supplementary Figure 1 compares subject N006's PCI baseline score with the baseline group mean score and standard deviation.

Discussion and Conclusions

The present study attempts to investigate the state of consciousness induced by yoga nidra by adopting an integrated approach to investigating its phenomenological and neurophysiological aspects. We found that yoga nidra is a powerful meditative practice capable of inducing an altered state of consciousness characterized by dissociative effects, perceived bodily expansion, increased sacred meanings attributed to the experience, and reduced rationality and volitional control of thoughts. High-density EEG recordings during the nidra sessions revealed that no common signs of non-REM sleep (e.g., K-complexes and sleep spindles) were present in any of the participants anywhere during the practice. Moreover, one descriptive high-density EEG power analysis suggested that yoga nidra is related to an initial increase of alpha and beta power that progressively reduces as the practice deepens, an increase of theta power specific to the nidra 1 stage, and a final later increase of gamma power.

The increase of dissociative effects is an original result that has been rarely investigated during meditation. The fact that meditation can induce effects such as out-of-body experiences, distorted body and visual perceptions, and alterations in the sense of self should not be confused with dissociative disorder symptoms: Even if meditative states of consciousness share some similarities with dissociative states, there are important differences between them.[35,36] In fact, the ability to adopt a witnessing attitude, not dissociating but decentering from consciousness contents in an adaptive way, is one of the main positive outcomes of meditation, which is also explored in "third wave" cognitive behavioral therapies, such as mindfulness-based interventions.[37,38] The perception of experiencing or having experienced an unusual state of consciousness is often present during and after meditation, as is apparent from previous studies using the same instrument.[21,22,23,26,39] Moreover, the ability to perceive of being or having been in an unusual state of consciousness is considered one of the main criteria to decide whether one experienced a "full" altered state of consciousness.[40]

Another common and expected outcome was the alteration of body image and body scheme. Subjects reported the feeling of losing their body boundaries, so it seemed they no longer had any limits and could expand in the outer world. This finding has been reported as a common factor in a variety of meditative practices and seems independent from the specific practice. This feeling is possibly related to modulations of interoceptive abilities, related in turn to anterior insula activity and, from a phenomenological

standpoint, to a modified perception of the self.[41–43] (See Lou et al.[44] and Millière et al.[45] for a review.) The "enhanced meaning" outcome is a relatively neglected aspect of altered states of consciousness. However, this is a common dimension of mystical experiences, described by Stace during the 1960s[46] and characterized by increased sacredness perception, a sense of encountering something holy or sacred, and increased "noetic quality" (i.e., the feeling of encountering an ultimate reality that is "more real" than usual everyday reality).[47] Moreover, the long-term meaning-enhancing properties of meditative practices have not been much studied, but they share some similarities with those obtained recently in the psychedelic psychotherapy field.[48–50] The reduction of rationality and volitional control of thoughts are two important outcomes, in line with two fundamental studies on yoga nidra performed by Lou and colleagues.[14,15] These two phenomenological features are commonly described during the hypnagogic states before sleep and relate to the progressive increase of parasympathetic dominance.[51,52] In addition, a study from our laboratory described a reduction of rationality and volitional control during ultra-slow stimulation of the nasal vault, an artificial condition simulating slow breathing techniques.[21]

Nonsignificant phenomenological results are also interesting to discuss. Reduced perceived fear and increased joy were expected because of the high relevance of positive emotional experiences during a wide range of meditative practices.[53] According to the PCI results, the presence of high self-consciousness, together with no changes in memory, indicates maintained awareness during nidra. A high level of self-consciousness, moreover, is a common finding in other meditative practice studies adopting the same questionnaire.[21,22,23,26] Surprisingly, in the present study we did not find any increase in imagery amount or vividness. This could be due to the length of the sessions (2 hours) making it difficult to recall vivid imagery experiences that are usually present in the early phases of yoga nidra.[7] Finally, unchanged introspection and absorption (very high both during baseline and yoga nidra), as well as unchanged arousal and internal dialogue (very low both during baseline and yoga nidra), may be related to the high level of meditative experience of our subjects, who were perfectly able to introspect, relax, and control mental rumination even during a short resting state: This is a learned meditative trait commonly reported in the contemplative neuroscience field.[21,54–56]

Regarding EEG visual inspections, we found no EEG signs of sleep (e.g., delta waves, K-complexes, and sleep spindles) in any of the participants during the practice. The present results contradict the predictions of Parker et al.,[7] who expected delta-wave predominance similar to slow-wave sleep during wakefulness in the deepest stages of yoga nidra. We can interpret this finding as the proof that all subjects performed the whole session correctly without falling asleep. EEG results also confirm phenomenological reports of maintained self-awareness and are in line with scientific literature on the delta band. In fact, even if delta power's role in modulating faster oscillations and in a variety of motivational and cognitive functions is well-known, delta-wave predominance during wakefulness in adults has been only linked to pathological states (e.g., vegetative state, epilepsy) and (nonconscious) non-REM sleep.[57] Even during sleep, consistent literature confirms the role of delta power increase in unawareness, as assessed with analysis of both non-REM and REM sleep dreams.[58]

Regarding descriptive EEG power analysis for subject N006, alpha and theta changes are coherent with the first two stages of yoga nidra in the model of Parker et al.[7] We can interpret later widespread alpha-power decrease as an index of the default mode network's reduced activity and connectivity, commonly associated with reduction of spontaneous self-referential thoughts and mental rumination.[59,60] In addition, parietal posterior beta-power decrease has been related to bodily awareness modifications such as alterations of body ownership and self-location during deep meditative states.[61] Theta-power increase during nidra 1 replicates the findings of Lou et al.[14] and is a widely assessed outcome across a variety of meditation practices, mainly related to a state of enhanced internally directed attention.[62] As already noticed in other contemplative practices, we interpreted the later gamma-power increase as an index of enhanced awareness, top-down attention, and perceptual clarity,[16,63–65] characterizing the nidra state of consciousness. These findings at the phenomenological and EEG levels preliminarily suggest that the practice of yoga nidra may exert its positive effects on mental health and well-being via similar mechanisms to those investigated within the field of mindfulness-based contemplative practices—that is, top-down attentional training, emotion regulation, increased body awareness, and change in self-perspective.[66]

Although present findings are promising, some methodological limitations need to be considered. First, this is a preliminary study, as it lacks a control group and has a small sample size. However, we must stress the fact that yoga nidra is a rarely investigated practice, and experienced meditators are very hard to recruit. Moreover, phenomenological characterization of yoga nidra was possible only considering the session as a whole, precluding the possibility to independently analyze every stage. Future studies may attempt this separation, adopting real-time assessment using brief questionnaires such as the Nondual Awareness Dimensional Assessment-State.[67] Future studies will also address the longitudinal effect of continuous yoga

nidra sessions, likely during a week-long retreat period. It is plausible that sessions performed at the beginning of the retreat will be significantly different from those performed at the end of the retreat. Finally, we are aware that a single EEG power spectral analysis is not representative of the nidra state, even if it still can shed some light on its neurophysiological basis. Future studies should increase sample size and include a matched active control group. Moreover, to avoid excessive presence of artifacts and noisy signal, and considering the long duration of the yoga nidra sessions (2 hours), we recommend gel-based EEG electrodes instead of water-based sensors.

Taken together, the present results enrich scientific knowledge on yoga nidra, indicating that it is a powerful practice for eliciting altered states of consciousness, sustained by specific psychophysiological and phenomenological correlates, whose therapeutic potential needs further study. Finally, we want to stress that even if yoga nidra has been classified within the cognitive domain of the taxonomy proposed by Nash et al.,[8] the voluntary directing of top-down attention, body-scan, and guided visual imagery[68] mean that it also shares important features with the so-called null domain (i.e., methods that purport to create a noncognitive/nonaffective state, an enhanced empty state devoid of phenomenological content). In fact, cognitive training and focused attention are present only during the initial stages of the practice, whose final aim is to reach the dissolution of all conscious contents and the experience of nothing but pure awareness.

Conflict-of-Interest Statement

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The authors received no specific funding for this work.

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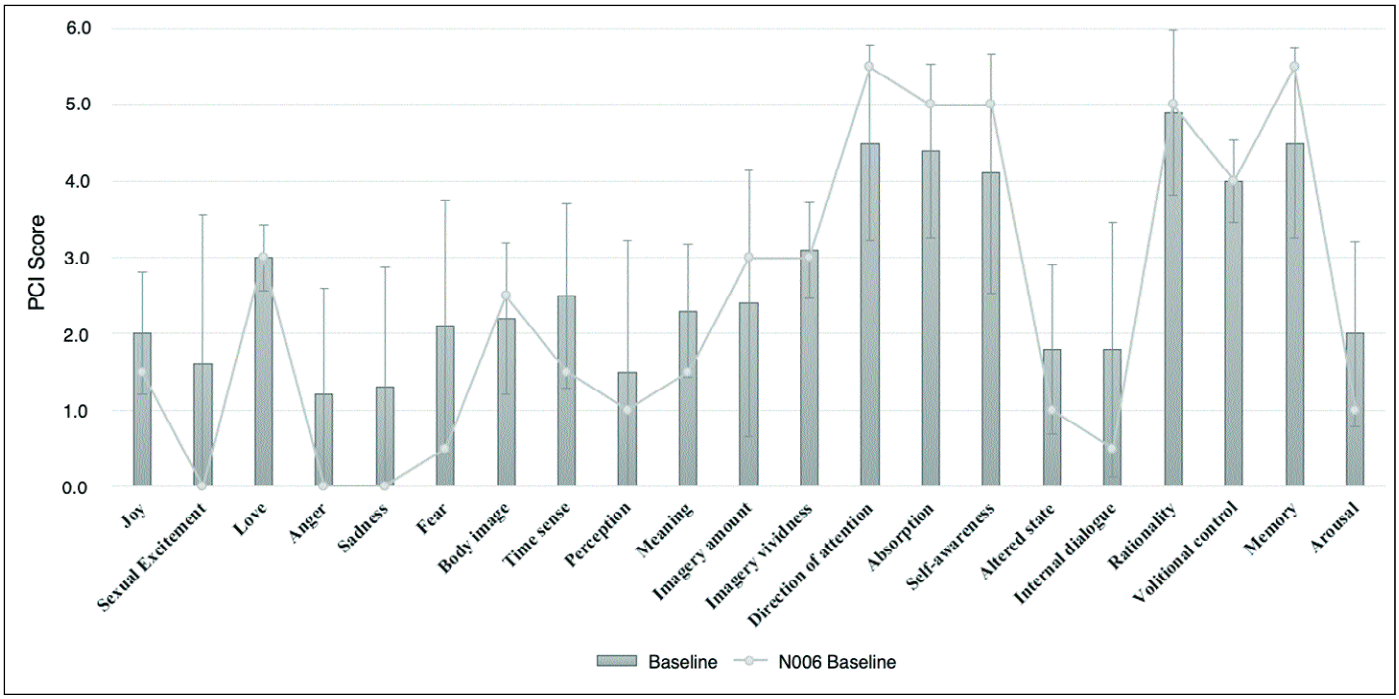
Supplementary Table 1. Psychometric Questionnaire Results[a]

	Baseline (SD)	Yoga Nidra (SD)	*z*	*p* Value	Corrected *p* Value	*r*
CADDS	4.3 (5.18)	21.1 (15.65)	–3.064	0.002*	0.022*	0.885
PCI subscale						
Joy	2.0 (0.80)	3.1 (1.52)	–1.886	0.059*	0.161	0.544
Sexual Excitement	1.6 (1.96)	0.6 (1.18)	–1.476	0.140	0.308	0.426
Love	3.0 (0.43)	3.7 (0.85)	–1.838	0.066	0.161	0.531
Anger	1.2 (1.40)	0.9 (1.29)	-0.632	0.527	0.644	0.182
Sadness	1.3 (1.58)	0.7 (1.60)	–1.156	0.248	0.420	0.334
Fear	2.1 (1.66)	0.6 (1.16)	–2.246	0.025*	0.079	0.648
Body image	2.2 (1.00)	4.4 (1.40)	–3.061	0.002*	0.022*	0.884
Time sense	2.5 (1.21)	3.2 (1.01)	–1.335	0.182	0.364	0.385
Perception	1.5 (1.72)	2.1 (0.82)	–1.100	0.271	0.426	0.318
Meaning	2.3 (0.88)	3.8 (1.07)	–2.747	0.006*	0.026*	0.793
Imagery amount	2.4 (1.74)	2.6 (0.92)	–0.178	0.859	0.859	0.051
Imagery vividness	3.1 (0.63)	2.5 (1.21)	–0.866	0.386	0.566	0.250
Direction of attention	4.5 (1.28)	4.5 (1.35)	–0.222	0.824	0.859	0.064
Absorption	4.4 (1.14)	4.4 (1.03)	–0.508	0.611	0.708	0.147
Self-awareness	4.1 (1.57)	3.5 (0.93)	–1.177	0.239	0.420	0.340
Altered state	1.8 (1.11)	3.9 (0.91)	–2.904	0.004*	0.026*	0.838
Internal dialogue	1.8 (1.67)	1.2 (1.45)	–0.667	0.505	0.644	0.193
Rationality	4.9 (1.08)	3.8 (1.08)	–2.633	0.008*	0.029*	0.760
Volitional control	4.0 (0.54)	2.5 (0.96)	–2.807	0.005*	0.026*	0.810
Memory	4.5 (1.24)	4.6 (1.02)	–0.255	0.799	0.859	0.074
Arousal	2.0 (1.21)	1.9 (1.58)	–0.654	0.513	0.644	0.189

[a]The yoga nidra state of consciousness was compared to baseline as assessed by CADSS total score and by scores of each PCI subscale.
*Statistically significant.
CADSS = Clinician-Administered Dissociative States Scale; PCI = Phenomenology of Consciousness Inventory; SD = standard deviation.

Supplementary Figure 1. Baseline State of Consciousness of Subject N006, as Assessed by Scores of Each PCI Subscale, Compared to the Baseline Group Mean Scores and Standard Deviations for Each PCI Subscale



PCI = Phenomenology of Consciousness Inventory.