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Electrophysiological Correlates of Higher States of Consciousness During Sleep in Long-Term Practitioners of the Transcendental Meditation Program

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Summary: Standard ambulatory night sleep electroencephalograph (EEG) of 11 long-term practitioners of the Transcendental Meditation (TM)® program reporting "higher states of consciousness" during sleep (the experimental group) was compared to that of nine short-term practitioners and 11 non-practitioners. EEG tracings during stages 3 and 4 sleep showed the experimental group to have: 1) theta–alpha activity simultaneously with delta activity and 2) decreased chin electromyograph (EMG) during deep sleep ($p = 0.002$) compared to short-term practitioners. Spectral analysis fast Fourier transform (FFT) data of the first three cycles showed that: 3) the experimental subjects had significantly greater theta2 (6–8 Hz)–alpha1 (8–10 Hz) relative power during stages 3 and 4 than the combined control groups [$t(30) = 5.5$, $p = 0.0000008$] with no difference in time in delta; 4) there was a graded difference across groups during stages 3 and 4 in theta2–alpha1 power, with experimentals having greater power than short-term practitioners, who in turn had greater power than non-practitioners [$t(30) = 5.08$, $p = 0.00002$]; and 5) experimentals also had increased rapid eye movement (REM) density during REM periods compared to short-term practitioners ($p = 0.04$). Previous studies have found increased theta–alpha EEG activity during reported periods of "transcendental consciousness" during the TM technique. In the Vedic tradition, as described by Maharishi Mahesh Yogi, transcendental consciousness is the first of a sequence of higher states. The maintenance of transcendental consciousness along with deep sleep is said to be a distinctive criterion of further, stabilized higher states of consciousness. The findings of this study are interpreted as physiological support for this model. **Key Words:** Sleep—Subjective—EEG—Meditation—Altered states of consciousness—Alpha.

Throughout history, various cultures have described the existence of so-called "extraordinary" states of awareness beyond waking, dreaming, and sleeping (1,2). While such transcendental experiences in the West are often considered ephemeral or momentary (1), the ancient Eastern view of development emphasizes their possible maintenance in daily life outside practices such as meditation (3–6).

In particular, Maharishi Mahesh Yogi's Vedic Psychology describes the existence of "higher states of consciousness" with values of self-awareness qualitatively distinct from those experienced during the ordinary states of waking, sleeping, and dreaming (4–6). According to this model (4–6), the first higher state of consciousness experienced beyond the three ordinary states is termed "transcendental consciousness" (4). Transcendental consciousness is described as a deeply restful yet fully alert state of inner wakefulness with no object of thought or perception (5). The Transcendental Meditation (TM)® program involves a mental technique held to promote the experience of transcendental consciousness. Self-reported experiences of transcendental consciousness during practice of the TM technique have been shown to be correlated with a stable, non-descending theta–alpha (7–9 Hz) pattern and breath suspensions (7–14).

Further, this model (4–6) holds that transcendental consciousness is not only experienced in a transitory manner during the TM technique, but through repeated regular practice, it comes to be spontaneously maintained throughout daily life. When transcendental consciousness is continuously maintained during waking, dreaming, and especially deep sleep, then the first of three permanent higher states of consciousness is said to be stabilized (4). The term "witnessing" is used to describe this state because transcendental conscious-

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ness is experienced to be a non-changing level of awareness that serves as a peaceful inner observer or "silent witness" to the active changing states of waking, dreaming, and sleeping.

Previous studies of participants in the TM program have found evidence of delta waves and alpha spindles during deep sleep (8), a beta pattern during light sleep (8), a significantly higher ratio of high-frequency rapid eye movements (REMs) to low-frequency REMs (15), increased REM density during REM periods (15), and significant peaks in theta–alpha power during the brief transitions between waking, non-rapid eye movement (NREM)-sleep, and REM-dreaming (16). These studies (8,16) were not necessarily done with subjects who reported witnessing sleep.

A phenomenological experience with some similarities to witnessing is lucid dreaming. Lucid dreaming is the condition of being aware that one is dreaming while the dream goes on and requires a combination of detachment and participation (17). In contrast, in subjective accounts of witnessing the dream state, one is completely separate from and uninvolved in the dream activity and completely identified with transcendental consciousness (18). Pilot studies suggest that lucid dreaming involves a more active mental state corresponding to greater physiological arousal than witnessing dreaming (19–22), but it is premature to conclude at this point that lucid dreaming and witnessing dreaming are completely distinct phenomena, and they may represent a continuum of experiences (22).

Based on maintenance of transcendental consciousness along with deep sleep as the primary criterion of putative higher states of consciousness, we predicted that subjects reporting a higher state of consciousness during sleep would display a greater theta–alpha (6–10 Hz) activity that is typically associated with transcendental consciousness, occurring along with the delta (0.25–4 Hz) pattern typical of sleep stages 3 and 4. To avoid possible misinterpretation of the results, a number of diseases and sleep disorders including sleep state misperception, insomnia, parasomnias, pain, and fibrositis (23–26) that involve polysomnographic atypical alpha (primarily an *alternating* alpha with delta pattern) were screened for in the present study. Furthermore, the electroencephalograph (EEG) spectral analysis concentrated on NREM stages 3 and 4, as opposed to REM or stage 2, to avoid confusion with lucid dreaming (19–22) or "wakeful-like" stage 2 reports (27).

METHODS

Subjects

Experimental subjects (nine female, two male) were healthy, long-term practitioners of the TM technique [mean and standard deviation (SD) = 17.8 ± 4.9 years of practice] who reported higher states of consciousness during sleep. One group of control subjects (nine female, two male) consisted of short-term practitioners of the TM technique (1.4 ± 0.8 years) who were matched for left- or right-handedness with the experimentals but reported no experiences of higher states of consciousness during sleeping. EEG recordings for two female short-term control subjects were not analyzable due to loss of data in the analog-to-digital (A/D) tape-transfer procedure. All subjects practicing the TM technique were volunteers who were either directly affiliated with Maharishi University of Management in Fairfield, IA, or were living in the surrounding community. All subjects were currently free of medication, had not used tobacco products for at least 1 year, and consumed alcohol and caffeinated beverages only rarely.

A second control group of 13 females ranging in age from 21 to 36 (29.5 ± 1.5 years) who had not practiced the TM technique was also available. As in the case of the TM subjects, these women were judged healthy and did not use tobacco products or consume alcoholic beverages. One of these subjects was left-handed, approximately matching the experimental group (two left-handed) and the short-term controls (two left-handed). Two of the non-practitioner controls were eliminated due to their inability to fall asleep or indications of periodic leg movements.

One design priority was to contrast practitioners of the TM technique who were witnessing sleep with the short-term, non-witnessing control group. Witnessing has been found to increase with length of time meditating (6). Thus, to better ensure a witnessing-free control group, we chose controls who were short-term in their length of practice and who also reported no subjective experiences of witnessing.

The short-term practitioners tended to be younger than long-term practitioners because in this relatively youthful university setting 1) most of the new practitioners were younger and 2) many of the older new practitioners who could be located had begun the TM program on the advice of a physician as treatment for a pre-existing health problem, which made them ineligible for participation in the study. Because the witnessing subjects had usually practiced the TM technique for many years they tended to be older. Thus, as a result of our design priorities, the experimental group had the older mean age of 39.7 ± 5.0 years, ranging from 31 to 50, compared to the short-term practitioners' mean age of 27.1 ± 4.8 years, ranging from 24 to 36, a difference that was significant [$t(18) = 5.680$, $p = 0.00002$] (see Discussion).

Data from the non-practitioner group were acquired through a collaborative effort with Duke University

Sleep Laboratory (Marsh and Elias, in preparation). The data were deemed acceptable for comparison to the TM practitioner data because the training, research procedures, montage, type of recording equipment, and software analysis package were all the same. All data were transformed from analog to digital at the Duke facility. The bands analyzed for the non-practitioner group were theta2 = 6–7.75 Hz and alpha1 = 8–10 Hz. The bands analyzed for the experimental subjects and short-term controls were theta2 = 6–7.75 Hz and alpha1 = 8–9.75 Hz. Although the alpha bands were a quarter of a hertz wider for the non-practitioner control group than for either of the TM groups, contribution to the relative power comparisons, if any, would be minimal and would oppose the predicted differences. Bands are referred to below as 6–8 Hz or 8–10 Hz for easy comprehension.

Procedures

Health problems were evaluated with a written health history for all three groups. A mental health questionnaire (28) was administered to experimental subjects and short-term TM controls to exclude those suffering from mental illness; no such subjects were identified. Basic criteria for the subjective experience of witnessing during sleep were a self-reported affirmation that "I experience a quiet, peaceful inner awareness or wakefulness during deep sleep" and awaking refreshed from sleep. The criterion for both control groups' experiences was that they "lost conscious awareness while sleeping". Experience of growth toward a higher state of consciousness during sleep was determined using the M-scale (29), the States of Consciousness Inventory (SCI) (30), a sleep experience questionnaire, and an in-depth structured interview with complete agreement on scores by two independent judges.

Experimental subjects and short-term controls maintained their usual bedtimes, and if they awoke earlier, they were instructed to simply remain in bed until 6:00 a.m. They avoided napping, alcohol, drugs, and caffeine. Non-practitioner controls went to bed at their usual bedtimes, but if they arose earlier, they had the option to leave their beds. (This difference of procedure would not have influenced the primary measurement because it involved only the first three sleep cycles.) All subjects gave an account of their activity level and current state of health immediately before recording and upon awakening completed a standard sleep questionnaire [similar to (31)] with additional questions on pain, as well as on higher states of consciousness for TM practitioners. Information on menstrual cycle stage (32) was required of all female subjects.

All three groups were recorded in their homes (33) with monopolar recordings from C3 to A2, from C4 to A1, electrooculograph (EOG) (upper and lower outer canthus), and electromyograph (EMG) (mental and submental) with a recording time constant of 0.3 seconds and a high filter of 45 Hz using Oxford Medilog 9000 recorders (Oxford Medical Ltd., Clearwater, FL). All procedures conformed to the Declaration of Helsinki.

Electrophysiological analysis

A 100-microvolt EEG channel calibration signal was provided using Medilog XM-90. Data were digitized at 128 points/second (a constraint of the recording equipment) with tape stabilization and transferred with a Scientific Solutions (Solon, OH) A/D board model AD221 at 20× speed for all three groups. Recordings were visually scored for sleep stages, artifacts were rejected, and NREM and REM sleep cycles were defined according to established criteria (34). Data were conditioned using Hanning cosine-tapered windows and were spectral analyzed using fast Fourier transformations (FFTs) from EEG. SYS analysis software (Friends Medical Science Research Center, Baltimore, MD, Sleep 5.21) in 4 second windows.

Automatic (EEG.SYS) rapid eye movement analysis was based on a minimum amplitude of 30 microvolts base to peak with a minimum of 250 millisecond intervals between eye movements and REM density calculations on 20 second epochs. The EMG analysis was based on the lowest quartile of EMG relative power with a time constant of 1 second (35). To control for individual differences in muscle tone, EMG was standardized relative to mean waking values.

Statistical methods

First, time spent in different stages of sleep was analyzed to determine possible differences in sleep architecture. This was followed by an analysis of power in the delta band. As noted previously, because the witnessing group had been meditating substantially longer and thus was older than the short-term practitioners, it was anticipated that age would be confounded with (and, in part, a proxy variable for) treatment status. To assess this expectation, we determined the strength of intercorrelations of group status, length of time meditating, and age. For the main outcomes, a global comparison was performed using analysis of variance (ANOVA) to assess possible differences between the groups in the average theta2–alpha1 relative power during the first three cycles of stages 3 and 4 sleep. ANOVA tables were reviewed to determine the

TABLE 1. *Visually scored sleep measures, means, and standard deviations*

Sleep measures	Group 1 witnessing experimental group (n = 11) Mean (SD)	Group 2 short-term practitioner control group (n = 9) Mean (SD)	Group 3 non-practitioner control group (n = 11) Mean (SD)	ANOVA for all three groups *F* value (df)	p value
Total time in bed (minutes)	460 (47)	496 (68)	409 (71)	4.95 (2,28)	<0.05**
Stage 2 latency (minutes)	32 (23)	24 (22)	16 (5.5)	2.06 (2,28)	ns
Total stage 1 (minutes)	78 (31)	51 (19)	11 (4)	23.3 (2,28)	<0.001**, ***
Total stage 2 (minutes)	144 (55)	191 (47)	171 (34)	2.62 (2,28)	ns
Total stages 3, 4 (minutes)	78 (43)	77 (31)	96 (40)	0.79 (2,28)	ns
Total REM (minutes)	79 (30)	94 (32)	93 (28)	0.83 (2,28)	ns
REM latency (minutes)	85 (28)	86 (25)	75 (26)	0.57 (2,28)	ns
Awake after onset (minutes)	15 (14)	6 (14)	32 (17)	0.51 (2,28)	ns
Movement time (minutes)	4 (8)	3 (5)	1 (1.3)	0.12 (2,28)	ns
Cycle 1–3 stage 1 (minutes)	40 (21)	33 (15)	6 (3)	61.4 (2,28)	<0.001*, **, ***
Cycle 1–3 stages 3, 4 (minutes)	69 (36)	70 (21)	85 (32)	0.79 (2,28)	ns

SD, standard deviation; df, degree of freedom; REM, rapid eye movement; ns, $p > 0.05$.
Group comparisons: * $p < 0.05$ between group 1 and group 2; ** $p < 0.05$ between group 2 and group 3; *** $p < 0.05$ between group 1 and group 3.

sources of variation attributed to treatment status and age for the global comparison. Then, five planned contrasts with ANOVA were performed for three groups with treatment status as the independent variable and relative theta2–alpha1 power as the dependent variable. We then tested the homogeneity-of-slopes assumption to determine the statistical appropriateness of covarying for age. To be conservative, we then performed the five planned contrasts co-varying for age. Last was the analysis of the EMG, REM density, and psychological measures. Although directional predictions are necessary for planned contrasts, all test results are shown two-tailed also to be conservative.

RESULTS

Sleep architecture

Table 1 presents the means and standard deviations for parameters of sleep architecture. There were no significant differences between groups in standard sleep measures except in stage 1 sleep and time spent in bed. These were apparently due to variations in procedures, as previously explained (see Procedures).

Visual inspection of raw EEG records from the witnessing group indicated a distinctive and pronounced appearance of theta–alpha waves simultaneously riding the delta of stages 3 and 4 sleep. There were also periods of low EMG during delta sleep.

Figure 1 presents an EEG tracing during stage 3 of a representative 45-year-old female long-term practitioner reporting experiences of witnessing during sleep. The first line (C3–A2) and the third line (C4–A1) show the simultaneous theta–alpha waves and delta activity. The second line presents eye movement activity. The fourth line shows decreased EMG during stage 3 sleep.

Delta spectral analysis results

In absolute delta, there was no significant difference between experimentals and short-term practitioner controls by multivariate analysis of variance (MANOVA) [$F(1,18) = 0.447$, $p = 0.499$ for stages 3 and 4] for the first three cycles of sleep, where the majority of delta for the night occurs. FFT results were not available in absolute power format for the non-practitioner controls due to the need to conserve computer memory at the Duke University Sleep Lab.

Average theta2–alpha1 relative power

Figure 2 shows greater average theta2–alpha1 relative power in the experimental group for stages 3 and 4 over the first three cycles of sleep as compared to short-term practitioner and non-practitioner control groups.

However, because the witnessing group was significantly older than the control groups, we first examined the degree to which age may have been confounded with years meditating and treatment status. Significant correlations were found between age and years meditating ($r = 0.74$) between age and treatment status ($r = 0.60$) and between treatment status and years meditating ($r = 0.86$). This age confound with length-of-time meditating, and hence with treatment status, led us to perform statistical comparisons in two ways: first, without covarying for age (because of the obvious confound of age with length of time meditating) and second, covarying for age (which is rather con-

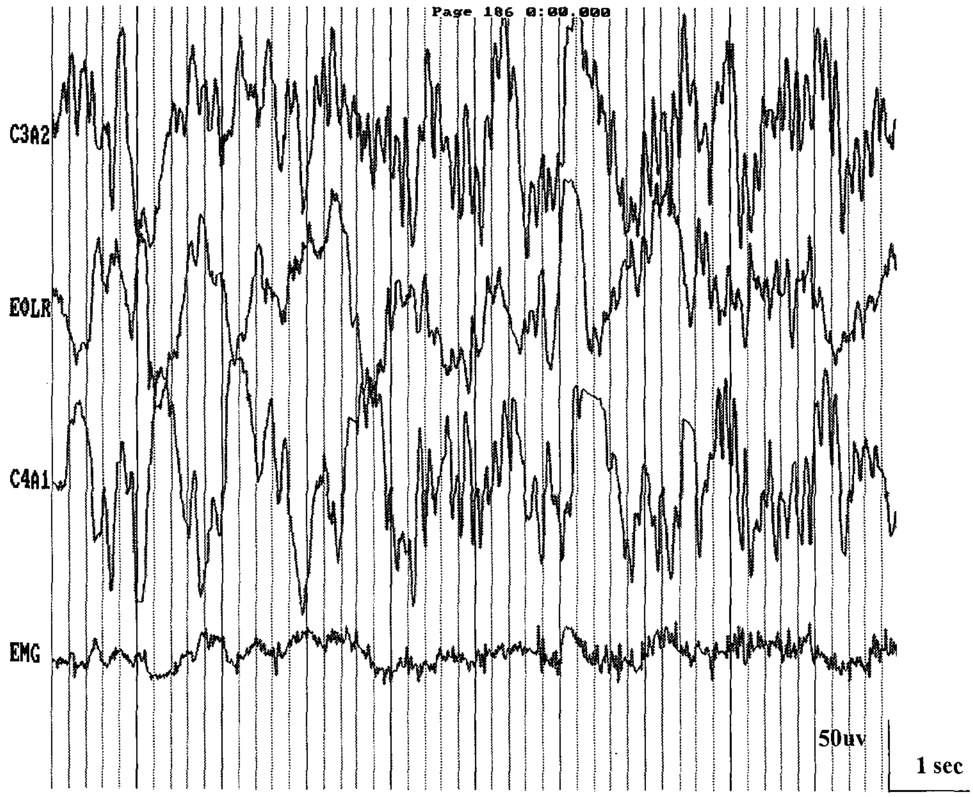

FIG. 1. Electroencephalograph (EEG) tracing from a healthy 45-year-old female reporting experiences of higher states of consciousness during sleep. (C3–A2) and (C4–A1) show simultaneous theta–alpha waves and delta activity of stage 3 sleep with decreased electromyograph (EMG). The time constant was 0.3 seconds with a high filter of 45 Hz. (sec, second; μv, microvolts.)

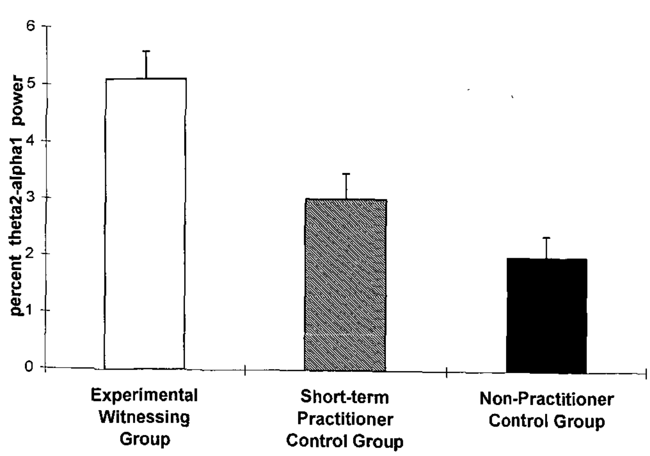

FIG. 2. Comparison of theta2 (6–8 Hz) and alpha1 (8–10 Hz) relative power for the first three cycles of stages 3 and 4 sleep in experimental subjects, short-term practitioners, and non-practitioners. With no significant differences between the groups in time in delta sleep, there was a graded difference in theta2–alpha1 with the experimental subjects greater than the short-term practitioners, who in turn were greater than the non-practitioners [$t(30) = 5.08$, $p = 0.00002$]. The experimental group had significantly greater theta2–alpha1 than the short-term practitioner controls [$t(19) = 3.70$, $p = 0.001$] and significantly greater theta2–alpha1 than the non-practitioner controls [$t(21) = 5.81$, $p = 0.000006$].

servative given that age is in large part a proxy variable for years meditating and treatment status).

In a global comparison of all three groups (experimental, short-term practitioner, and non-practitioner) the omnibus F was significant for average relative theta2–alpha1 power over the first three cycles of stages 3 and 4 sleep [$F(2,28) = 17.46$, $p = 0.00001$]. The same analysis covarying for age was also significant [$F(2,28) = 6.04$, $p = 0.007$]. Differences between the three treatment groups accounted for 55.5% ($r = 0.75$) of the total variance in theta2–alpha1 power. As expected, the shared variance between age and treatment status was high—39.4% of the variance ($r = 0.63$). Also as anticipated, when covarying for age, the proportion of variance accounted for by treatment status was substantially reduced but still at 16.2% ($r = 0.40$) was a large effect size. The unique contribution of age was 8.1% or $r = 0.28$.

Main contrasts

The following contrasts are also for the first three cycles of stages 3 and 4 sleep.

1. The experimental group had significantly greater theta2–alpha1 relative power than the two control

groups together [$t(30) = 5.5$, $p = 0.0000008$], including when covarying for age [$t(30) = 2.06$, $p = 0.05$].

2. There also was a graded effect with the experimental group having greater theta2–alpha1 power than in the short-term practitioners who, in turn, had greater power than the non-practitioners [$t(30) = 5.08$, $p = 0.00002$], including when covarying for age [$t(30) = 3.41$, $p = 0.002$].

Additional contrasts

3. The experimental group had significantly greater theta2–alpha1 than the non-practitioner controls [$t(21) = 5.81$, $p = 0.000006$] including when covarying for age [$t(21) = 2.98$, $p = 0.006$].

4. The experimental group had significantly greater theta2–alpha1 than the short-term practitioner controls [$t(19) = 3.70$, $p = 0.001$], but significance was lost when covarying for age [$t(19) = 0.98$, $p = 0.34$].

5. The short-term practitioners had a trend for greater theta2–alpha1 than the non-practitioners [$t(19) = 1.82$, $p = 0.08$], and significance was reached after covarying for age [$t(19) = 2.38$, $p = 0.013$].

EMG and REM density

In addition to a pattern of theta–alpha superimposed on delta, the experimental group exhibited significantly more 20 second epochs with highly reduced EMG during stages 3 and 4 sleep as compared to short-term practitioner controls [$t(18) = 2.8$, $p = 0.011$] (see Fig. 1). When made relative to waking EMG, the significance was even greater [$t(17) = 3.7$, $p = 0.002$]. The experimental group also had greater computer-scored REM density during REM for the first three cycles compared to short-term practitioner controls [MANOVA for repeated measures $F(1,18) = 4.71$, $p = 0.04$]. EMG and REM density computerized measures were not available in the non-practitioner control group.

Psychological measures

The experimental (witnessing) subjects had significantly higher scores on the States of Consciousness Inventory (30) [$t(14) = 4.7$, $p < 0.0005$] and the M scale (29) [$t(19) = 2.8$, $p = 0.014$] with no significant differences in mental health scores (28) [$t(19) = 1.4$, $p. = 0.139$] compared to short-term practitioner controls.

DISCUSSION

In this study, 11 long-term practitioners of the TM technique reporting the experience of witnessing during sleep showed greater relative power in theta–alpha during stages 3 and 4 delta wave sleep, with no difference in time spent in delta compared to the two control groups. One control group consisted of short-term practitioners and another consisted of non-practitioners of the technique. The witnessing subjects also exhibited significantly more periods of decreased EMG in deep sleep and a significant increase in REM density during REM relative to the short-term practitioner control group. Because each ordinary state of consciousness (waking, deep sleep, and REM sleep) is accompanied by a unique subjective description of experience as well as state specific EEG, EMG, and eye movement patterns (36), a distinctive physiological pattern in subjects reporting witnessing of sleep is interpreted as support for a different state of consciousness. The Vedic tradition describes several "higher" states (3,6) in which the principal criterion is the subjective experience of witnessing, a situation in which a silent unchanging awareness, also known as transcendental consciousness, occurs simultaneously with waking, dreaming, and especially deep sleep. The increased theta–alpha activity found here, coexisting with the delta activity of deep sleep in subjects reporting transcendental consciousness during sleep, is interpreted as support for this Vedic description of higher states because increased theta–alpha activity has been reported previously for periods of transcendental consciousness during the TM technique.

For this conclusion to be sound, however, possible explanations based on alternate factors that include 1) age, 2) functional disturbances, 3) arousal, 4) lucid dreaming, and 5) alpha-sleep must be excluded. The evidence and rationale for concluding that these have been successfully excluded is summarized here.

Age

A priority in designing this study was to control for a wide range of self-selection factors by comparing long-term TM practitioner experimental subjects with short-term TM practitioner control subjects. Witnessing has been predicted (4) and found (6) to increase with length of time meditating so the criterion of short-term TM practice, in addition to that of an absence of witnessing sleep, was applied in selecting the TM practitioner controls.

Practitioner volunteers who were healthy, older, and also had only recently started to practice the technique were not accessible (see subject section). However, because others have not found either increasing NREM alpha over the age range of 22–64 years (37) or correlations across a wide range of ages between age and NREM theta–alpha power (38), the inability to find control groups that were more closely matched in age to the witnessing practitioner group was not considered a serious limitation.

Given that length of time meditating is held to be a causal factor in developing witnessing (4,5), it would follow that the experimental group would be comprised of relatively long-term TM practitioners. Indeed, the average years meditating was 17.8 in the witnessing group compared to only 1.4 for the short-term controls. Therefore it is not surprising that the experimental subjects would be significantly older. In fact, there was a very high intercorrelation between length of time meditating, age, and treatment status.

Therefore age appears to be primarily a proxy variable for length of time meditating. Nevertheless, to be conservative, we covaried for the effect of age. Even though 71% of the total variance accounted for by treatment was shared with age (which was largely due to years meditating), when this shared variance was removed, the effect of treatment status was still statistically significant for the two main contrasts and two of the three additional comparisons. Furthermore, if age was the most parsimonious explanation for the present results we would not have expected the TM controls (24–36 years) to have more theta–alpha production that the non-practitioner controls (21–36 years) with nearly identical mean ages.

Nevertheless, age did appear to have a smaller independent effect. Future research closely matching witnessing and non-witnessing subjects across a wide range of ages will enable us to directly measure any independent as well as interactive effects of witnessing and age on theta–alpha activity during deep sleep.

Note the apparent increase of the theta–alpha power even in the short-term practitioners may reflect the gradual infusion of transcendental consciousness into sleep associated with the cumulative effect of the practice. Perhaps only when the degree of infusion of transcendental consciousness (and corresponding theta–alpha activity) reaches a threshold is it subjectively experienced as witnessing. Future longitudinal research could address this possibility.

Functional disturbances

The subjects were screened for general good health and specifically for disorders including fibrositis, chronic pain, sleep state misperception, parasomnias, and insomnia-type complaints. In addition, no known sleep disorder has been found to exhibit an EEG pattern like the unusual one found in the present study (23–26). Thus, functional disturbance is not indicated as a source of the observed theta–alpha activity in sleep.

Arousal

Arousal is also not indicated as the source of greater theta–alpha relative power in the present study because stage 1 sleep, awakenings, arousals, and movement artifacts were identified as part of the visual scoring process and were excluded in this analysis of only stages 3 and 4 sleep.

Lucid dreaming

One could argue for a possible confusion between subjective reports of lucid dreaming and reports of witnessing during sleep. However, during interviews and in written questionnaires, the present experimental subjects, as well as others (18), were able to distinguish lucid dreaming from witnessing deep sleep and from witnessing dreaming. The findings of a simultaneous theta–alpha and delta EEG pattern occurring during NREM sleep, along with low EMG, support the conclusion that these correlates of transcendental consciousness during sleep reflect a proposed higher state distinct from lucid dreaming. Lucid dreaming occurs almost exclusively during phasic REM and more often during later REM periods (20). The physiological changes during slow-wave sleep found in the present study in the witnessing group are not reported in subjects identified primarily as lucid dreamers (17,20,21).

Alpha sleep

In addition to the current study, one other researcher (39) has described an increase of theta–alpha in delta wave sleep, but the electrophysiological signature in those studies appears different from the one found here. Our pattern of simultaneous theta–alpha and delta was accompanied by periods of decreased EMG during stages 3 and 4 sleep and increased REM density during REM (39,40,41). Neither of these was found in the report of alpha sleep (39).

In conclusion, therefore, possible confounds of EEG data due to age, functional disturbances, arousal, lucid dreaming, or alpha sleep are unlikely to provide an acceptable alternative explanation of our results.

EMG and REM density

During waking, periods of momentary heightened alertness are associated with reduced motor activity (42,43). Also, decreased muscle activity has been reported during a different type of meditation technique than that reported here (44). Heightened orientation or alertness and increased brain activity during REM sleep are also associated with an inability to move or atonia. However our subjects with decreased EMG displayed synchronous alpha–theta and delta unlike the desynchronized EEG of REM possibly indicating a different mechanism underlying the atonia of witnessing sleep.

Autonomic patterns with some similarities to the orienting response have been found during the experience of transcendental consciousness during practice of the TM technique as well (14). Periods of low EMG also were reported previously in practitioners of the TM technique at the end of slow-wave sleep periods during night sleep (16). The low EMG seen in the present study during witnessing of deep sleep may thus be related to the orienting response seen during waking and REM (13,14,42,43,45,46) and may be a sign of increased inner alertness.

Our findings and previous reports (15) of increased REM density in subjects witnessing sleep could be viewed as an indication of a somewhat lessened sleep depth due to the inner awareness of witnessing (47). REM density also has been found to increase with maturation, increased intelligence, and stage of development (48).

A collection of previously reported psychological [see reviews (3,6)] and multi-dimensional physiological findings (7–16) supports reports of growth of higher states of consciousness. The present results add to these earlier data, providing further support for the existence of higher states of consciousness as described by Maharishi Mahesh Yogi (5). These higher states of consciousness have been phenomenologically associated with profound changes in experience of the ultimate nature of the Self and its relationship to the world (3–6,16,18,22). These higher states also appear to have practical implications because of their association with improvements on psychological development (6), physical health (49) and well-being (3,50).

The present evidence for the existence of higher states of consciousness during sleep also has direct implications for sleep medicine. The potential exists for subjective experiences of higher states during sleep to be misdiagnosed by the uninformed as insomnia or sleep state misperception. However, according to the theoretical model supported by the present results (4,5), insomnia or ordinary sleep contrasts sharply with witnessing sleep, which is the distinct, continuous experience of a state of inner awareness known as "transcendental consciousness" during deep sleep.

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