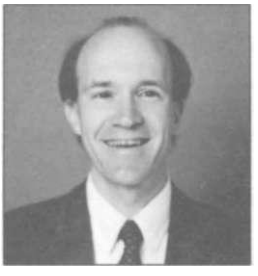
About the Author



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An Empirical Test of Maharishi's Junction Point Model of States of Consciousness

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Abstract

In the 22nd lesson of his course, the Science of Creative Intelligence (SCI), entitled "SCI and the Fourth State of Consciousness," Maharishi Mahesh Yogi describes a fourth state of consciousness, transcendental consciousness (TC), that can be located at the junction points of the three relative states—waking, dreaming and sleeping. The present study tests whether this model, called here the "junction point model," can be objectively verified. Electroencephalographic (EEG) patterns during Transcendental Meditation (TM) practice were compared to EEG patterns during the transition between waking and sleeping.

Two sets of independent data showed alpha activity spreading to the front and slowing 1-2 cycles/sec during TM practice as well as during the junction point between waking and sleeping. There were no significant differences in power or in coherence between these two periods. However, the time course was quite different. During TM this EEG pattern persisted for the entire 25-minute session, while the junction point between waking and sleeping lasted for a mean of three minutes. These data support the conclusion that waking, dreaming, and sleeping are active modes of an underlying field, transcendental consciousness, that can be experienced in the transition between relative states of consciousness and during TM practice.

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Modern Science and Vedic Science, Volume 4, Number 1, 1990

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Introduction

Maharishi Science of Creative Intelligence (SCI) systematically studies fundamental regularities in nature. The specific expressions of these principles are investigated in the different disciplines of modern science. These fundamental SCI principles can provide models to guide scientific research.

A model that has guided my investigation into electroencephalographic (EEG) patterns of states of consciousness is the "junction point model" of states of consciousness. This model is based on two observations: that waking, sleeping, and dreaming states of consciousness are completely different from each other, and that they alternate throughout the 24-hour period. Because they are completely different from each other, Maharishi Mahesh Yogi (1972) asserts that one state must completely fade out before another begins. That point where one state has faded away and another has not yet begun is defined as the junction point. This junction point could be argued to be either a unique point or an overlap of two states; both possibilities are discussed below.

Maharishi presents the following qualities of the junction point: (1) it is a field of consciousness, because the active states of consciousness (waking, sleeping, and dreaming) arise from it—"a stream of consciousness will only start from a field of consciousness" (Maharishi Mahesh Yogi, 1972, p. 22-6); (2) it can be located at any time or in any place—"therefore, time and space are no barriers to the continuous existence of that value of consciousness" (Maharishi Mahesh Yogi, 1972, p. 22-6); (3) it is unmanifest, without specific qualities or active modes of consciousness—"waking, dreaming, and sleeping, come out from there and end there, but that in itself is non-changing" (Maharishi Mahesh Yogi, 1972, p. 22-6); and (4) it is the source of all creativity and intelligence expressed in waking, sleeping, and dreaming—it is the "source, course, and goal" of these relative states (Maharishi Mahesh Yogi, 1972).

This junction point model describes the relationship of the relative, changing states

of waking, dreaming, and sleeping with a fourth state:

> The three relative states of consciousness exist and run through their continuous, everchanging alternation on the basis of the fourth state, which is Absolute, non-changing, ever the same, always present yet hidden, underlying the three relative states. (Maharishi Mahesh Yogi, 1972, p. 22-7)

Figure 1 schematically presents waking, sleeping, and dreaming as characteristic waves of activity, expressions of the underlying field of pure, transcendental consciousness. At any point in time, this model suggests, the value of transcendental consciousness can be found along with some expressed value. Between any two states there could be a point at which the first has faded away, and the next has not yet faded in—shown as the gaps between waves in the figure. This would be the experience of the fourth state of consciousness at the junction point.

Does this junction point model in fact describe how the three relative states of consciousness are related to the fourth state, transcendental consciousness? EEG patterns

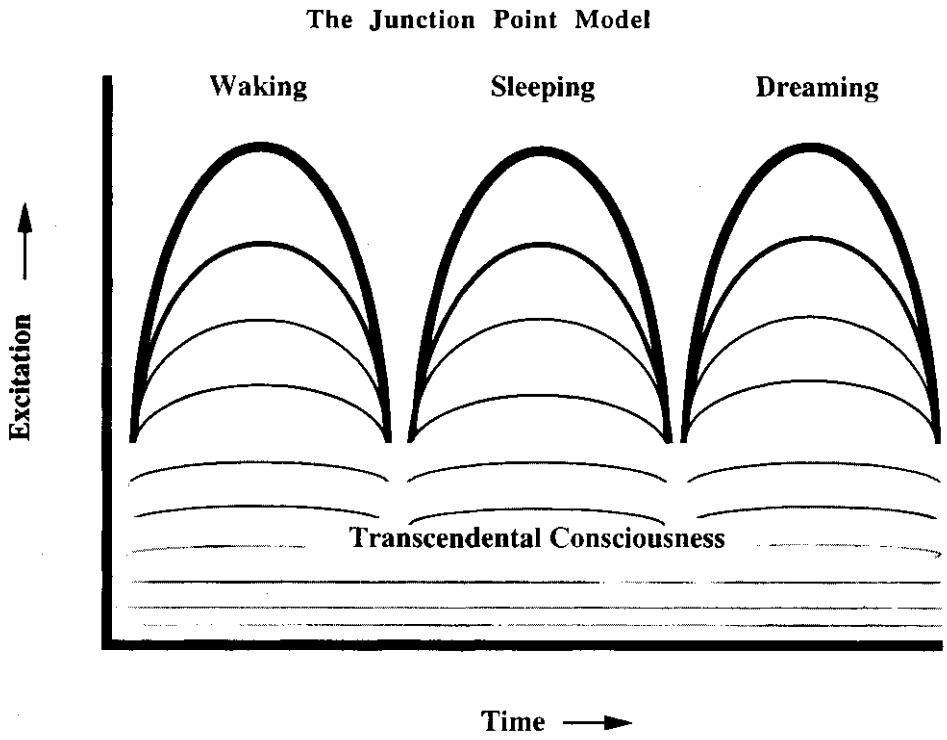

Figure 1. The x-axis represents time, and the y-axis represents level of excitation. Transcendental consciousness, the fourth state of consciousness, is the state of least excitation of consciousness. The three relative states of consciousness are specific patterns of activity, or excited modes of this fourth state.

reflecting the process of transcending—experiencing less excited levels of the mind—and periods of transcendental consciousness have been identified during practice of the Transcendental Meditation (TM) technique, a natural procedure that systematically provides direct experience of transcendental consciousness. If the junction point model accurately describes the relationship of the three relative states with transcendental consciousness, then EEG patterns in the transition between waking and sleeping (here called the junction point) should be similar to EEG patterns during TM.

Maharishi suggested this possibility in 1966 in *The Science of Being and Art of Living:* "Through the practice of Transcendental Meditation, the nervous system... receives a new status. This status can be located at the junction of any two of the three states of consciousness" (p. 134). He echoed this idea in SCI lesson 22:

> A definite change in physiology will bear witness to a style of functioning of the nervous system which corresponds to none of the three commonly experienced states. There is a state of functioning of the nervous system which is a transitional stage. This is the junction point. (Maharishi Mahesh Yogi, 1972, p. 22-5)

EEG is a critical physiological test of this model because it provides an indication of how the nervous system functions in each state of consciousness. Similar EEG patterns during the junction point and during TM would suggest that physiological functioning and, therefore, experiences are similar in the two conditions.

The junction point model was tested with two independent sets of EEG data, both of which included EEG during TM practice and during the junction point of waking and sleeping. In the present paper, the junction point was defined by EEG patterns typically seen during the transition between waking and sleeping. The beginning of the junction point was marked when alpha activity spread from back to front and slowed 0.5-1.5 cycles/sec; the end of the junction point was marked by the beginning of Stage 1 sleep: when more than half the alpha activity was replaced by low-voltage mixed-frequency activity (Rechtschaffen & Kales, 1968; Broughton, 1987).[1] This pattern of slowing and spreading of alpha activity has also been reported during TM practice (Wallace, 1970; Banquet, 1973; Levine, Hebert, Haynes, & Strobel, 1977), and indicates the process of transcending: systematically experiencing finer, more subtle states of thinking, and transcending the subtlest state of thinking to arrive at pure consciousness (Maharishi Mahesh Yogi, 1966).

The first data set analyzed here was derived from Levine's work published in 1977; figures presented in his paper were examined in light of the junction point model. The second data set is from my research, which compares EEG patterns during TM practice with those during eyes-closed rest in a nonmeditating control group (Travis & Orme-Johnson, 1990). The methods and results of both experiments will be presented first; results will then be discussed together in light of Maharishi's junction point model.

1The junction point differs from hypnogogic sleep, which begins with the transition from waking to sleeping, continues through Stage 1 sleep, and end with the onset of Stage 2 sleep (Schacter, 1976).

Review of Levine's Data

Method

Levine et al. (1977) was the first to use coherence COSPARs (COmpressed SPectral ARrays) to characterize states of consciousness. COSPARs present estimates of power or coherence over time on a single graph by plotting spectral estimates for successive time intervals, in this case every five seconds, one above the other.

Subjects. Levine recorded EEG from 80 experienced teachers of the TM program learning the TM-Sidhi program[2] in residence. He used data from 28 of these subjects to demonstrate typical patterns seen during eyes-closed rest, TM practice, and sleep. These 28 subjects comprised 15 males and 13 females, with a mean age of 31 years, ranging from 19 to 67 years. They had practiced the TM technique for an average of 71 months, ranging from 24 to 170 months.

Apparatus. EEG was recorded on a Grass 78D polygraph through 7P511-J amplifiers using a low filter setting of .3 Hz. and a high filter setting of 100 Hz. The EEG was digitized on line at 50 points/second by a Mega Tek Laboratory interface and stored for later editing of artifacts and spectral analyses.

Procedure. EEG was recorded from electrodes at frontal, central, parietal (top back), temporal (directly above the ears), and occipital (back) sites. A typical experiment involved five sequential periods: 5 minutes with eyes open, 10 minutes with eyes closed, 20-30 minutes of TM practice, 10 minutes with eyes closed, and 5 minutes with eyes open.

Analysis. Coherence was calculated between the front electrodes (F3F4), and between the left and right pairs of frontal and central electrodes (F3C3, F4C4). Coherence is a "measure of the consistency of relationship between matched frequency components of two signals" (Levine et al. 1977, p. 187), and seems to reflect functional and anatomical connectivity (French & Beaumont, 1984).

Results

Figure 2 was created from Levine et al.'s (1977) figures 21 and 14, which present COSPARs of coherence estimates during sleep (left) in a 27 year-old male with 42 months' TM practice, and during TM practice (right) in a 31 year-old female with 62 months' TM practice. These COSPARs display coherence calculated between EEG signals recorded at F3 and C3 for the 480 five-second epochs of the 40-minute experimental period. To highlight coherence peaks over time, Levine graphed only those coherence estimates greater than .95. Both x-axes represent frequency in Hertz (Hz or cycle/second). The y-axes show time in minutes on the left side and condition on the right side. The right-hand y-axis of the sleep COSPAR is divided into an eyes-closed alert state (EC), the junction point, and sleep, based on the EEG categories mentioned earlier.

[2]The TM-Sidhi program, learned after some months of regular TM practice, is designed to accelerate the growth of consciousness. Maharishi has described the full potential of human consciousness in his Vedic Science (see Maharishi Mahesh Yogi, 1986 and Gelderloos & Berg, 1989).

Comparison of COSPARS During Sleep and During TM

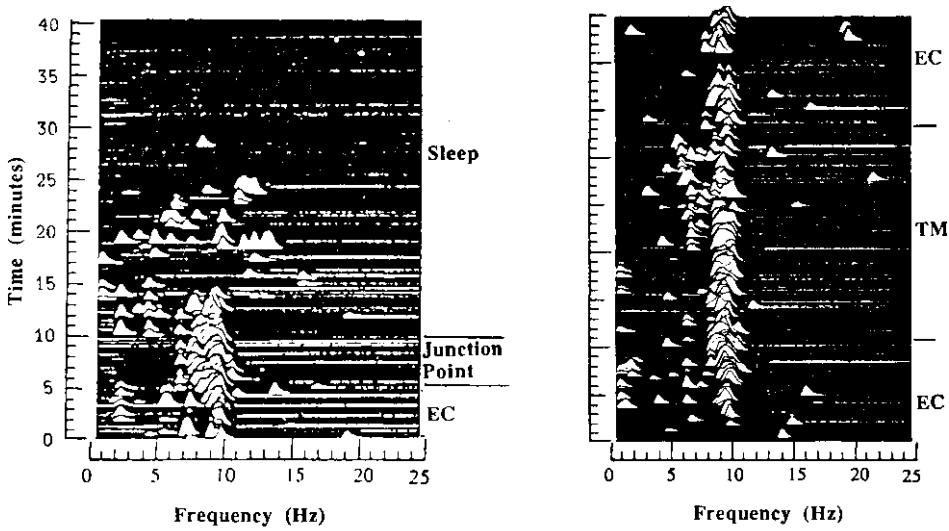

Figure 2. COSPARs of coherence estimates during sleep in a 27 year-old male with 42 months TM practice are shown on the left, and during TM practice in a 31 year-old female with 62 months TM practice on the right. The coherence patterns during the junction point, from the 5th to the 10th minute of the left COSPAR are similar to those during the entire 25-minute TM period. During the junction point this pattern lasted five minutes; during TM it lasted for 25 minutes.

It is apparent that coherence patterns during the junction point (from the fifth to the tenth minute of the left COSPAR) are similar to those during the 25-minute TM period. Both periods can be characterized as predominately 10-Hz alpha activity seen during the eyes-closed period, slowing .5-1.5 cycles/sec to 8-9Hz. This similarity of EEG is all the more remarkable because it was recorded from different subjects.

Although the patterns are similar, there is a difference in time course. During sleep this pattern lasts for five minutes and then disappears with the beginning of Stage 1 sleep. In contrast, these 8-9 Hz peaks continue throughout the entire TM session and into the EC period afterwards.

Review of Current Research

Method

Subjects. Ten experienced TM subjects (mean age = 29.8 yrs, SD = 8.38, range 20 to 45) and ten matched comparison subjects not familiar with this program (mean age = 28.7 yrs, SD = 7.95, range 19 to 47) were asked to participate in the study. Since handedness, gender, and age affect EEG patterns (French & Beaumont, 1984), all subjects were right-handed males matched for age.

Apparatus. EEG was recorded on a Grass 78D polygraph through 7P511-J amplifiers, using a low-filter setting of 1 Hz and a high-filter setting of 100 Hz. The EEG signal was digitized on line at 240 points/sec by a DEC 11/23 minicomputer and stored for later editing of artifacts and spectral analyses.

Procedure. EEG was recorded using the Electro-cap system from six electrodes, F3, F4, C3, C4, P3, and P4, referenced to linked ears. After the electrodes were applied, the subjects moved into a sound-attenuated room and sat on sheet-covered foam. EEG was recorded during a ten-minute session in which the TM subjects practiced TM and the comparison subjects rested sitting up with eyes closed.

Analysis. After eye and movement artifacts were removed, the data were conditioned with a cosine bell window (10% tapered onset and offset) to reduce oscillation near the windows' edges (Anderson, 1971), and spectral analyzed (fast Fourier transformation) in ten 1.06-second epochs in .94-Hz wide bands.

Results

The junction point was clearly marked in the comparison group's EEG by the slowing and spreading of alpha activity. Five minutes into the recording session, eight of the ten controls had clearly defined Stage 1 sleep, which marked the end of the junction point. There was no indication of drowsiness or sleep in the TM subjects. EEG during the junction point in the comparison group was compared to EEG during TM practice.

Figure 3 presents an example of the raw EEG from a comparison subject sitting with eyes closed (left) and a TM subject practicing the TM technique (right). For both subjects, the top six tracings (3A) are two minutes into the recording session, and the bottom six tracings (3B) are eight minutes into the recording session. The EEG activity during the entire TM period (both sets of tracings on the right side) is very similar to that of the junction point (top left tracings).

The coherence and power spectra averaged for all subjects in each group are presented in Figure 4. To calculate coherence and power, a standard procedure called a fast Fourier transform is used to mathematically decompose the complex waves (as seen in the third figure) into a sum of simple sine and cosine waves at various frequencies. If added back together, these simple sine and cosine wave components would yield the original complex wave. Power is calculated as the amplitude or amount of energy in each component at each frequency, and coherence is the phase relationship between these components across pairs of leads at each frequency.

Figure 4 presents coherence (top) and relative power[3] (bottom) estimates averaged over all subjects in each group. The standard error of the mean is indicated with error bars. Both groups' coherence and power spectra peak between 8-10 Hz, and statistical tests show they were not significantly different in theta, alpha, or beta bands.

[3]Relative power is the power in a specific frequency divided by the total power in all frequencies, and is expressed as a percent.

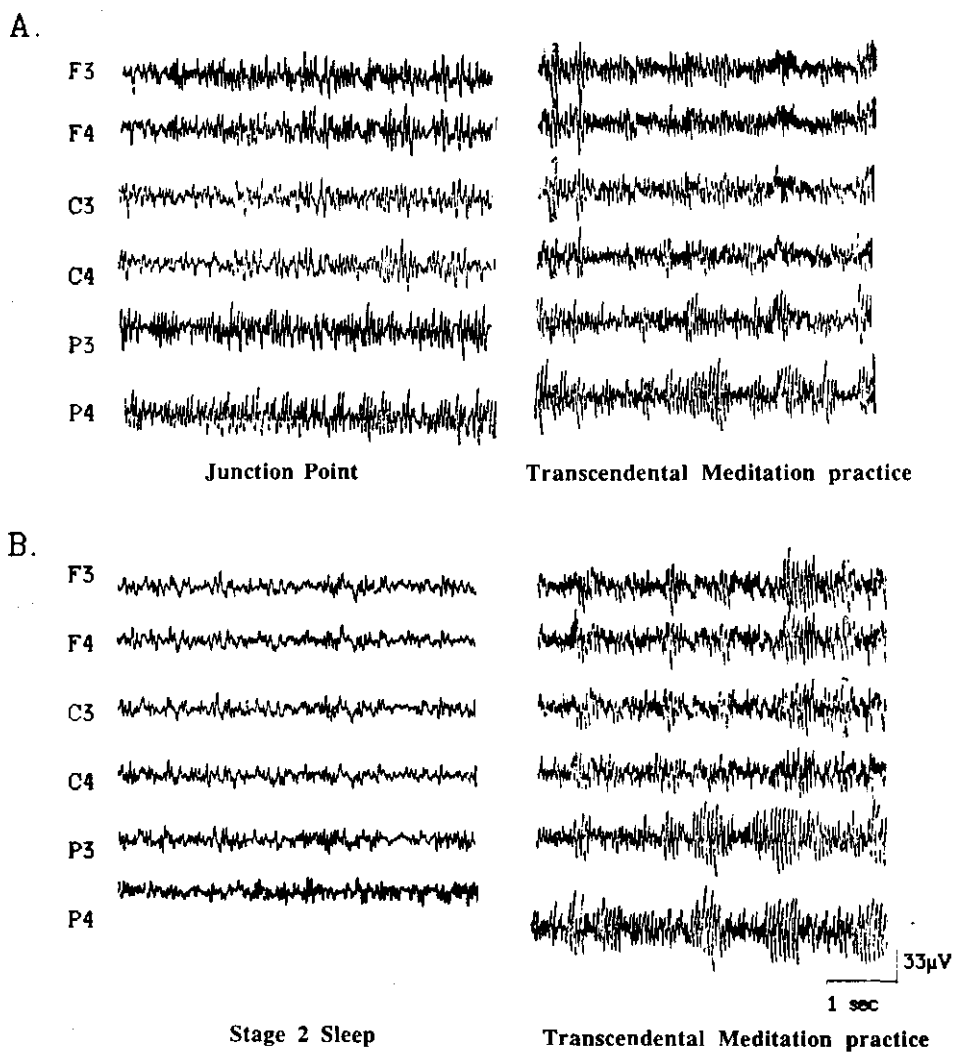

Figure 3. Raw EEG from a comparison subject resting with eyes closed is shown on the left, and a TM subject practicing the TM technique on the right. The top 6 tracings (A) are two minutes into the recording session, and the bottom 6 tracings (B) are 8 minutes later for the same two subjects. EEG was recorded from frontal, central, and parietal electrodes. Notice the similarity of EEG patterns during both TM tracings on the right and during the junction point between waking and sleeping in the upper left.

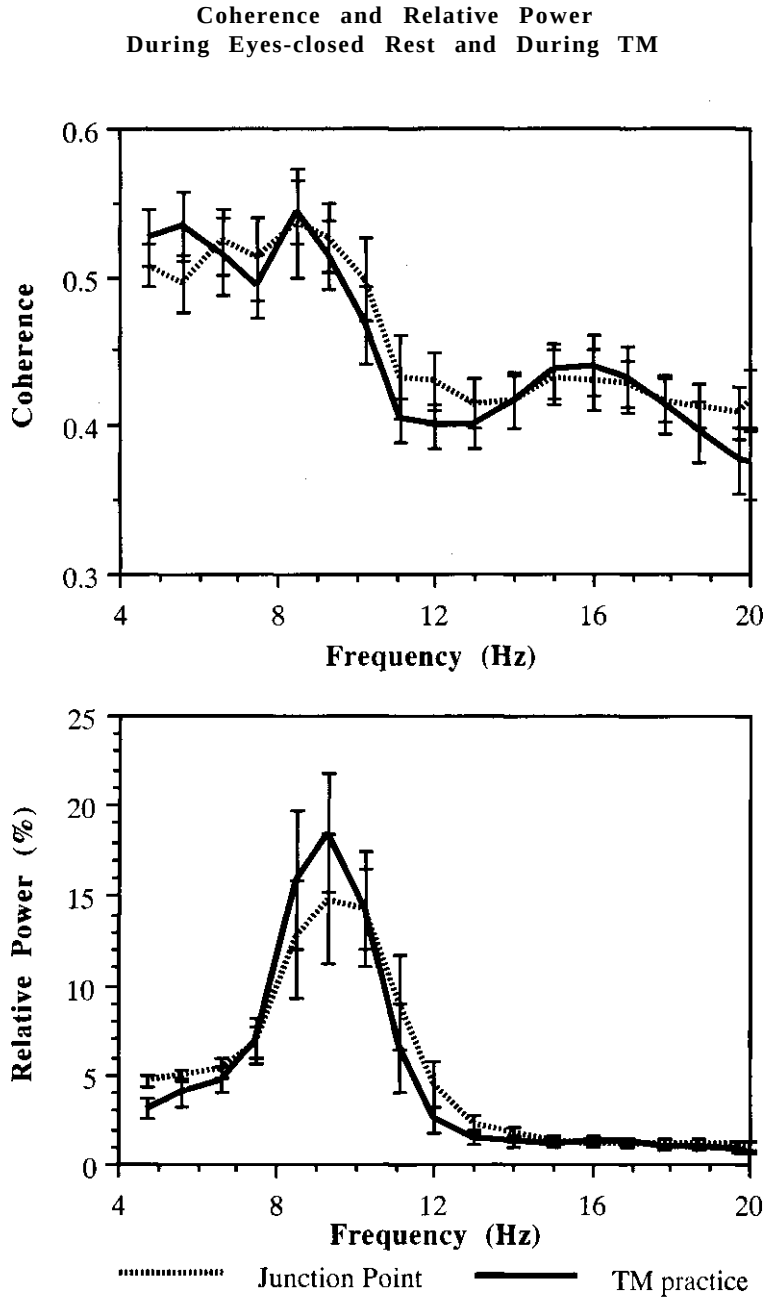

Figure 4. Coherence (top) and relative power (bottom) estimates were averaged over all subjects in each group. The standard error of the mean is indicated with error bars. Both spectra peak between 8-10 Hz, and are not significantly different in theta, alpha, or beta coherence or power.

Discussion

The EEG patterns during TM practice and during the junction point between waking and sleeping, as seen in these two independent data sets, are not significantly different.

Since EEG is an index of the functioning of the nervous system, this indicates that physiological functioning and therefore subjective experiences during the junction point and during TM practice may be similar.

The similarity of EEG patterns during the junction point and TM practice was earlier reported by researchers not familiar with the TM program. Fenwick et al. in 1977, concluded that during TM practice, awareness is "balanced between waking and sleeping." Schuman in 1980, and Pagano and Warrenburg in 1983, suggested that TM practice "freezes the hypnagogic process"—the transition from waking to sleeping. Wachsmuth and Dolce (1980) observed that TM subjects were able to maintain themselves "for unusually long periods in a state of decreased alertness."

These researchers based their conclusions from the perspective of waking state experience. They describe two states (waking and sleeping) closer together or further apart in time. This is a horizontal interpretation without the idea of a state underlying the activity of waking, dreaming, and sleeping. Although this horizontal interpretation describes the EEG data, it cannot explain why the EEG pattern lasts on the average of three minutes in the transition to sleep and for 25 minutes during TM. It also cannot explain why the EEG pattern seen during TM continues into the eyes-closed period after TM practice.

Maharishi's Junction Point Model

The junction point model gives a vertical interpretation of these data: "The three relative states of consciousness exist and run through their continuous, ever-changing alternation on the basis of the fourth state" (Maharishi Mahesh Yogi, 1972, p. 22-7). As we have seen, this model considers waking, dreaming, and sleeping to be active, manifest modes of the silent, unmanifest field of pure consciousness (see Figure 1). In the gap where the activity of one state of consciousness ends and the next has not yet begun, pure consciousness can be experienced. This is the junction point.

The junction point model explains the observed EEG patterns, as well as how that pattern may last for only a few minutes in the transition between waking and sleeping or for 25 minutes during TM practice. Between two states of consciousness, mind and body pass through a transition state that is the junction point. Maharishi explains that during TM practice, the experience of thought (characteristic of waking) is systematically and effortlessly refined until the finest experience of a thought is transcended and pure consciousness is experienced. It is experienced fleetingly as we pass from waking to sleep. It is experienced more systematically and more fully during TM practice, when we consciously take our awareness from change and activity to non-change and silence while remaining alert. Both the TM session and the three-minute transition from waking to sleeping comprise a mixture of transcending—refinement of

thinking—and periods of transcendental consciousness.

This EEG pattern is seen not only during the junction point between waking and sleeping; a similar pattern has been reported in the transition between sleeping and dreaming (Banquet & Sailhan, 1977). Also, during my postdoctoral research on sleep EEG, I saw 8-10 Hz rhythms before REM periods (between sleeping and dreaming) in about 5-10% of the records I analyzed. These records included almost 300 nights of sleep from nonmeditating children, young adult, and elderly populations. Research is currently underway to further test this model by quantitatively analyzing the junction points between sleeping and dreaming.

How can the physiology reflect the experience of the junction point when we are not subjectively aware of it? A large body of research in cognitive psychology suggests that experiences that are not reported are still registered by the nervous system. For example, emotionally-laden words presented subliminally still produce significant changes in galvanic skin response (Dixon, 1971). Also subliminally presented words improve performance on a lexical decision task (Neely, 1977) and on choice of a subsequent target word (Marcel, 1983). Psychophysical studies show that although the retina responds to a single photon, subjective experience of light requires seven photons (Goldstein, 1984, p. 28). These examples involve active processes during waking state. This same principle may be seen in the global transformation of states of consciousness: the nervous system may reflect experience of the junction point, as evidenced by specific EEG patterns and other physiological parameters, even though the experience is not reported.

While some people report the experience of the junction point, the majority do not. Maharishi (1972) comments that the nature of the three relative states precludes clear experience of the fourth state at their junction point:

> In shifting from waking to sleeping, for example, the awareness is becoming increasingly dull. As we become consciously dull, we are becoming increasingly incapable of perception (p. 22-7.... During dreaming, the experience only comes of imaginary things—not even imaginary, but delusive. (p. 22-8)

Therefore **one** would not be expected **to** regularly have the conscious experience of the junction point between waking and sleeping.

Is the Junction Point a Discrete State of Consciousness or a Blend of Two States?

The three relative states of consciousness are distinguishable by their EEG patterns (Niedermeyer, 1987), by brainstem nuclei activity, and by neurotransmitter concentrations (Hobson, 1989). Because they are completely different, a blend of any two would yield a third unique state. If the junction point were a blend of the preceding and the following states, there would be at least two transitional states of consciousness, one between waking and sleeping or sleeping and waking and the second between dreaming and sleeping or sleeping and dreaming. This "blending" is not supported by the data: the EEG patterns between waking and sleeping, between sleeping

and dreaming, and during TM practice are all similar. These similar EEG patterns suggest a similar experience in all three conditions. Therefore, the data better support Maharishi's junction point model of a unique state of consciousness that underlies waking, sleeping, and dreaming.

Research Design Implications of the Junction Point Model

These data bring out a practical point **for** research design, especially when studying states of consciousness: it is necessary to take the junction point model into account in the experimental design. If the control subjects become drowsy in the eyes-closed rest period, their EEG patterns will be a mixture of that found during the junction point and during alert eyes-closed rest, and therefore will confound any comparison with TM practice. To ensure that resting subjects remain alert, one might, for example, ask them simple true/false questions every minute, and record EEG between their responses.

Conclusion

EEG can reveal the functioning of the nervous system and thus answer basic psychophysiological questions. A comparison of EEG records suggests that Maharishi's junction point model accurately describes the relation of waking, sleeping, dreaming, and transcendental consciousness. EEG is now being used to explore a further prediction of Maharishis Science of Creative Intelligence, that the experience of transcendental consciousness could co-exist with waking, dreaming, and sleeping. Maharishi explains that, when stabilized, this experience is the foundation of what has been traditionally termed enlightenment, in which:

> . . . the opaque curtains of the three relative states of consciousness are no longer opaque; they are transparent. The window which was wooden before has somehow... been transformed into a glass window. (Maharishi Mahesh Yogi, 1972, p. 22-21)

This is the topic of research currently underway in the EEG lab at Maharishi International University.

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