PAPER 296

EEG COHERENCE AND THE LENGTH OF PRACTICE OF THE TRANSCENDENTAL MEDITATION PROGRAM

RANDI NIDICH, SANFORD I. NIDICH, DAVID W. ORME-JOHNSON, and R. KEITH WALLACE

Departments of Education, Psychology, and Biology,
Maharishi International University, Fairfield, Iowa, U.S.A.

Research completed April 1983.

Frontal, left, and overall EEG alpha coherence were found to be positively correlated with length of time practising Transcendental Meditation, indicating greater orderliness and integration of brain functioning as a result of the Transcendental Meditation programme.

This study investigated the relationship between years practicing the Transcendental Meditation (TM) technique and EEG alpha coherence in 37 undergraduate and graduate students from Maharishi International University (MIU). The subjects, 28 males and 9 females, had been practicing the TM technique for various lengths of time, between 2 and 13 years (X = 6.77). The average age of the students was 26.46. Subjects were tested for EEG coherence as part of MIU's psychophysiological testing program. All measures were monitored simultaneously with the mean coherence scores being derived from ten .53-minute periods during which all subjects practiced the TM technique. Pearson product-moment correlations were computed to determine the relationship between years meditating and frontal (F3, F4), left (F3, C3), right (F4, C4), and overall (F3, F4, F3, C3, F4, C4) EEG alpha coherence. Frontal, left, and overall EEG alpha were found to be positively correlated with years meditating (p < .05), and right EEG alpha was not found to be significantly correlated; (frontal, r = .336; left, r = .466; right, r = .283; and overall, r = .423). The above correlations were still found to be significant after partialing out the age of the subjects. In addition, IQ was found not to correlate significantly with EEG coherence. The results of this study indicate that the TM technique is a viable technology for enhancing EEG alpha coherence.
INTRODUCTION

The mammalian forebrain is responsible for cognitive functioning which goes beyond mere survival tendencies in man (MacLean, 1978, p. 332). The brain is not a single structure but is divided into two halves, the right and left hemispheres. The left hemisphere has been found to be predominantly involved with analytic processes and it appears to process input in a sequential manner. The right hemisphere appears to be responsible for highly developed and complex cognitive functioning (Luria, 1980). Research has indicated that the frontal lobes are associated with the ability to carry out complex, purposive, and goal-directed actions (Luria, 1980, p. 27). The prefrontal cortex has been found to provide foresight in planning for oneself and others and helps one to gain insight into the feelings of others (Chall and Mirsky, 1978, p. 340).

According to Beaumont, Mayes, and Rugg (1978), one of the best methods for investigating the dynamical organization status within the brain is through the use of EEG coherence data, which measures the correlation of two signals as a function of frequency, together with associated cross-phase spectra. EEG coherence can be understood as a measure of long-range order among widely separated brain cells (Domash, 1977).

One of the main uses of EEG coherence data has been to investigate changes that result in brain functioning due to the practice of the Transcendental Meditation and TM-Sidhi program. The TM technique is defined as turning the attention inwards towards the subtler levels of a thought until the mind transcends and experiences the source of thought, consciousness in its least excited state (Maharishi Mahesh Yogi, 1969). This state of least excitation of consciousness has been found to be the unified field of all the laws of nature (Maharishi Mahesh Yogi, 1982). The TM-Sidhi program, which is based upon the experience of the least excited state of consciousness, was derived by Maharishi from the Yoga Sutras of Patanjali and trains the ability of the individual to entertain intentions while established in the state of least excitation of consciousness.

Haynes et al. (1977) found that students who reported clear experiences of pure consciousness during the practice of the TM program had higher frontal EEG alpha coherence than those who did not report clear experiences. They also found that those who had higher frontal alpha EEG coherence had more rapid neuromuscular recovery and scored higher on the “usual uses” creativity sub-test than those who had lower EEG coherence.

Orme-Johnson and Haynes (1981) found that clarity of experiences during the TM and TM-Sidhi program are associated with higher levels of frontal and central EEG alpha coherence. In addition Orme-Johnson and Haynes (1981) found that the amount of frontal EEG coherence during the practice of the TM technique was significantly correlated with verbal creativity as measured by the Torrance Test of Creative Thinking. Dillbeck, Orme-Johnson, and Wallace (1981) found that frontal EEG coherence was significantly correlated with concept-learning flexibility. Nidich et al. (in press) found that frontal EEG alpha coherence during the practice of the TM technique distinguished cosmic orientation from noncosmic responses to a Kohlbergian stage 7 question, “Why be moral?” In addition, they found a positive correlation between the Principled Thinking scale of Rest’s Defining Issues Test and right homolateral EEG coherence. Dillbeck and Bronson (1981) found that subjects showed a significant increase in frontal alpha coherence as a result of practicing the TM technique over a two week period. Levine et al. (1977) also found evidence of increasing EEG alpha coherence as a result of the practice of the TM technique.

Since previous research on the brain has indicated that EEG alpha coherence significantly correlates with the development of positive human qualities such as creativity, concept learning flexibility, moral development, and neuromuscular reflex control, it is necessary to establish a means whereby one could develop maximum EEG coherence. Research findings indicate that EEG alpha coherence increases through the practice of the TM technique and that clear experiences of pure consciousness during the practice are associated with high coherence. The purpose of this study was to examine EEG alpha coherence in subjects practicing the TM program for various lengths of time. It was hypothesized that, independent of the factor of age, length of practice of the TM technique would be correlated with EEG alpha coherence.
METHOD

SUBJECTS—Subjects were 37 undergraduate and graduate students of Maharishi International University (MIU), 28 males and 9 females. The subjects came from a primarily middle class socio-economic background and the mean age of the group was 26.46.

Of the 37 subjects, all of whom practiced the TM technique, 17 were teachers of the TM technique. The range of the subjects’ years meditating was from 2 to 13 years, with a mean of 6.77 years.

APPARATUS AND PROCEDURE—The 37 subjects were tested for EEG coherence as part of MIU’s psychophysiological testing program. The EEG coherence measures used for this study were computed within the alpha frequency band for the pairs of leads F3, F4 (bilateral frontal); F3, C3 (left intrahemispheric); and F4, C4 (right intrahemispheric). All measures were monitored simultaneously with the mean coherence scores being derived from ten 53-minute periods during which all subjects practiced the TM technique. All recordings were monopolar referenced to linked ears. The EEG data was amplified by a Grass Model 78D 17-channel EEG and Polygraph. The data was digitized on-line in a Megatek Laboratory Interface connected to a Data General 32K Word Nova 3 minicomputer. Test/retest reliability coefficients over 3-4 months for frontal alpha, left alpha, and right alpha are reported by Orme-Johnson, Wallace, and Dillbeck (1981) to be .857, .848, and .740, respectively. When the EEG tests were administered, students were asked their age and how long they had been practicing the TM technique.

The Pearson product-moment correlation was used to determine if there was a relationship between EEG coherence and the amount of years practicing the TM technique. Analyses were conducted on frontal (F3, F4), left (F3, C3), right (F4, C4), and overall coherence as they relate to the number of years practicing the TM technique. In addition correlational tests were used to determine possible relationships between age and EEG coherence in frontal, left, right, and overall, and also to determine the relationship between age and years meditating. Partial correlations were conducted to determine whether the relationship of years meditating and EEG coherence is independent of age. Possible relationships between IQ and EEG coherence were also explored. Significance for all statistical tests was set at the .05 level, two-tailed.

RESULTS

Bilateral frontal, left, and overall (frontal, left, and right) EEG alpha coherence was found to be related to the number of years subjects practiced the TM technique. The correlation between frontal coherence and years practicing the TM technique was found to be .336 (p<.05). The correlation between left intrahemispheric EEG coherence with years meditating was .466 (p<.01); and the correlation between overall coherence and years meditating was .423 (p<.01). No significant correlation was found between right intrahemispheric EEG coherence with years meditating (r=.283). No significant correlations were found between age and EEG coherence (frontal, r=.150; left, r=.246; overall, r=.142) although a significant relationship between age and number of years meditating was found (r=.730).

When partial correlations controlling for age were computed it was found that significant relationships still existed between years meditating and frontal (r=.335), left (r=.433), and overall coherence (r=.473). Correlational tests (N=26) indicate that there is no significant relationship between IQ and frontal (r=-.130), left (r=-.121), or overall coherence (r=-.134) (table 1).

DISCUSSION

The data indicates that there is a significant correlation between years practicing the TM technique and frontal, left, and overall EEG alpha coherence. It was found by conducting partial correlations, controlling for the alternative explanation of age, that this rival explanation was eliminated without sig-
significantly affecting the correlation between years meditating and frontal, left, and overall EEG coherence. In addition IQ was found not to correlate significantly with EEG coherence. The above results indicate that the practice of the TM technique contributes to the development of higher levels of frontal, left, and overall EEG alpha coherence. This explanation is consistent with the theory that as one practices the TM technique and repeatedly experiences pure consciousness, the state of least excitation of consciousness, the psychophysiology of the individual becomes more integrated (Orme-Johnson and Farrow, 1977).

A rival hypothesis which had to be considered is that those who had been meditating the longest were teachers of the TM technique and therefore had greater intellectual knowledge of the TM program, which had an effect of increasing coherence during the program. A t-test was conducted showing that there was not a difference between the EEG coherence of teachers (N=17) and non-teachers (N=20; e.g. for overall coherence, t=1.01, NS). This is consistent with the fact that the practice of the TM technique is effortless and can be practiced successfully by anyone, independent of IQ or the amount of theoretical knowledge one may have attained.

In summary, the results of this study have indicated that significant relationships exist between years practicing the TM technique, and frontal, left, and overall EEG alpha coherence. It has also been inferred that, since these correlations hold up even after rival explanations have been considered, the continued practice of the TM technique directly influences EEG coherence.

This study has important educational implications. In previous research it was found that an integrated style of functioning of the frontal lobes contributes to the abilities of planning and foresight (Chall and Mirsky, 1978), increased creativity (Orme-Johnson and Haynes, 1981), and concept learning (Dillbeck et al., 1981). It was also found that the left hemisphere is predominantly involved with analytic processes and verbal skills and that the overall forebrain is associated with cognitive processing abilities (Springer and Deutsch, 1981). Since it has been the intention of educators throughout time to develop the individuals of their society to live their fullest potential, educators are encouraged to make use of the TM technique as an educational technology for promoting the psychophysiological development of their students. According to Maharishi (1969), the experience of pure consciousness, the state of least excitation of consciousness, is the key to developing the full potential of the student. As one practices the TM technique, this experience becomes more familiar as the state of least excitation of consciousness becomes more permanently established in one's awareness. The state of least excitation of consciousness being a field of perfect order and full integration becomes enlivened and gives rise to a more orderly and integrated style of functioning of the nervous system. Based upon this psychophysiological development, the student should perform better academically, and exhibit more ideal social behavior. A number of studies have already found that the practice of the TM program enhances cognitive performance and enriches social behavior (see e.g. Orme-Johnson and Farrow, 1977).

Future studies should longitudinally study school children who are tested before beginning the TM technique and several years afterward. In addition to EEG coherence measures, a battery of tests should be administered to assess the cognitive development of the student. It is predicted that students who are practicing the TM program will exhibit higher EEG coherence than control students of the same age and grade level, and that cognitive processing will be found to be at a higher level among students practicing the TM program.

REFERENCES


DOMASH, L. H. 1977. The Transcendental Meditation technique and quantum physics: Is pure consciousness a macroscopic quantum state in the brain? In Scientific re-


