

A COMPARATIVE MULTIDISCIPLINARY
INVESTIGATION INTO TWO
HYPOTHETICAL
ALTERED STATES OF CONSCIOUSNESS

Thesis submitted to the Department of Psychology, University of Cape Town,
in partial fulfilment of the requirements for the
Degree of Doctor of Philosophy in Psychology

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23rd March 1975

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ACKNOWLEDGEMENTS

Many people have contributed toward the completion of this work. I wish especially to thank the following: My supervisors, Dr. Arnold Abramovitz (for encouragement and advice and especially for his willingness and ability to offer criticism from the standpoint of my theoretical framework rather than his own) and Dr. Peter Beumont (for providing me with research facilities and opportunities for expanding my skills and interests via my participation in his research programs and for his valuable advice regarding the write-up of this study). Elizabeth Dixon, my fiancée/typist, for having not only typed and edited this manuscript but also for bearing with me throughout the difficult period of my involvement in this work. Lester Gilbert, for invaluable advice regarding choice of statistics and for his provision of the required computer programs.

Dr. Len Gribble, for having taught me much of what I know about electrophysiology and for having provided, by way of his approach to the field, an example that I attempt to follow. Martin Petersen and Oscar Enderstein of the EEG Department, Groote Schuur Hospital, for friendship and considerable technical assistance.

I wish also to thank my research assistants, particularly Karen O'Brien (autonomic balance experiments), Kenny Bledin (longitudinal psychological study on meditation) and Steve Touyz (a pilot longitudinal physiological study on meditation). My appreciation is extended also to my subjects for coping with the heavy demands made upon them. In this regard, I wish especially to pay tribute to the contribution made by one subject - Paddy Agnew.

The primary source of both my theoretical approach and a significant portion of the material contained herein was Professor W.P. Radloff. It is with pleasure that I am able to acknowledge the crucial role he has played in both the development of this work and in my development as a psychologist. Others who have contributed ideas of significance toward the present study include, Dr. Steve Edwards, Dr. H.I.J. van der Spuy, Renos Papadopoulos, Dr. Chris Orpen, Glynn Hirschman and Dr. Charles Palmer (formerly of SIMS).

I wish also to express my gratitude to the Departments of Psychiatry and Electroencephalography at Groote Schuur Hospital, to David Fiske and the International Meditation Society of South Africa and to the Law Society of the Cape of Good Hope (for providing facilities for the typing of this manuscript) for the co-operation I received.

Finally, I am especially thankful to my parents and late grandparents (Charles and Mary Doxey). The former for providing me, amongst other things, with an environment conducive to the production of this work and the latter for their keen interest and direct assistance.

The research described here was sponsored by grants provided by the Research Committee of the University of Cape Town and by the Human Sciences Research Council, Private Bag 41, Pretoria.

SUMMARY

The problem areas under examination may be conveniently considered under three interrelated headings.

1 Alpha Feedback Investigation

Twenty subjects participated in an alpha feedback training program of six weeks duration. On the basis of their performance at raising their alpha levels from pre- to post-training, they were assigned to either a "successful" or an "unsuccessful" group. For all subsequent experiments, both between-subjects (i.e., "successful" vs. "unsuccessful" groups) and within-subjects (i.e., "successful" subjects as self-controls) control procedures were employed.

The first aim was to determine whether, in fact, the phenomenon of operant alpha enhancement had been demonstrated. Employing automatic EEG analysis equipment and "normalising" the EEG data, it was found that over the short-term the "successful", but not the "unsuccessful", group produced significantly more alpha during their operant than during their free-operant conditions. In addition, although there was no significant difference between the two groups over the free-operant conditions, the "successful" group produced significantly more alpha during the operant conditions. It is suggested that this apparent demonstration of direct operant alpha enhancement - like all instances of the phenomenon - was probable instead mediated via the learned control of voluntary responses - the most likely of which may be oculomotor efferent activity.

A second aim was to determine the short-term physiological and behavioural concomitants of "successful" feedback-associated alpha enhancement and to determine the psychological correlates of the "successful" long-term practice of the technique. Over the short-term, occipital EEG and heart-rate data were obtained over experimental sessions comprising pre-experimental rest, experimental (or alpha feedback) and post-experimental rest conditions. In addition, pre- and post-experimental condition measures on autonomic balance, reaction-time and short-term memory/perceptual speed were obtained. The results indicated that the "successful" short-term practice was significantly accompanied by an enhancement in occipital alpha and a reduction in occipital beta. It was also found to be followed by a significant parasympathetic shift in autonomic balance.

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Over the long-term, the pre- and post-training scores of the two groups on 20 psychological dimensions were examined. The results indicated that "successful" long-term practice was associated with a reduction in "negative" and an enhancement in "positive" psychological characteristics. Specifically, "need for approval" and "neuroticism" were found to decrease whilst subjects construed themselves to be more "active" and more "involved". No evidence was obtained to suggest that social factors might have contributed measurably toward these effects.

"Successful" long-term practice was also found, in accordance with previously reported findings, to be accompanied by a significant enhancement in "hypnotic susceptibility". In going beyond previous research, however, it was found to be accompanied by a corresponding enhancement in "direct suggestibility". On the basis of these findings, it is suggested that alpha feedback training's apparent usefulness for raising "hypnotic susceptibility" is probably limited to relaxation-type hypnotic situations.

Finally, the subjective concomitants of "successful" feedback-associated alpha enhancement were examined by means of repertory grid techniques and it was found that the subjective data provided support for much of the findings generated by the other experiments.

2 Transcendental Meditation Investigation

Ten teachers of Transcendental Meditation participated in a short-term investigation into the physiological and behavioural correlates of Transcendental Meditation. Each subject was exposed to at least 9 hour-long sessions in the laboratory. For the subsequent experiments on this "advanced" meditator group, within-subjects control procedures were employed (i.e., subjects served as self-controls).

The third aim of the present study was to examine the occipital EEG correlates of meditation. Employing automatic EEG analysis equipment and "normalising" the EEG data, it was found that the practice was accompanied by a significant reduction in occipital alpha abundance and by a trend indicative of enhanced beta abundance. It is concluded that these data are consistent with the hypothesis that meditation may be accompanied by a forward migration of slower EEG activity and by an intensification of lower voltage fast activity over the posterior channels. Unfortunately, they are also not inconsistent with the hypothesis that meditation-associated EEG changes might be indistinguishable from those of light sleep. It is thus suggested that,

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Summary

in order to obtain decisive evidence on these two incompatible hypotheses, further similar EEG research into meditation is to be recommended in which, in addition to occipital EEG data, recordings from frontal and central channels are also examined.

The fourth aim was to determine the short-term physiological and behavioural concomitants of Transcendental Meditation. The heart-rate data of the "advanced" meditator group (as well as the occipital EEG data - see above) were obtained over experimental sessions comprising pre-experimental rest, experimental (or meditation) and post-experimental rest conditions. In addition, pre- and post-experimental condition measures on autonomic balance, reaction-time and short-term memory/perceptual speed were obtained. The results indicated that the practice was unaccompanied by changes in heart-rate. It was also not found to be associated with a subsequent change in autonomic balance nor with changes in reaction-time and short-term memory/perceptual speed. It is concluded that the failure to find a hypometabolic condition after meditation (which does not imply its absence or presence during actual meditation) raises doubt concerning the efficacy of meditation-associated hypometabolism as the underlying mechanism for the alleged meditation-associated psychological changes.

A fifth aim was to explore the psychological concomitants of regular meditation practice and to attempt to determine the role, if any, of factors related to changes in "need for approval" in bringing about measurable psychological changes. The subjects for this experiment comprised 28 beginning meditators who were assigned to either a "regular" or an "irregular" novice meditator group on the basis of their reported meditation-regularity over a period of approximately 6 weeks. For this experiment, both between- and within-subjects control procedures were employed. The pre- and post-training scores of the two groups on 19 psychological dimensions were examined. The results indicated that "regular" long-term practice was associated with a reduction in "negative" and an enhancement in "positive" psychological characteristics. Specifically, "anxiety" and "neuroticism" were found to decrease and "extraversion" to increase whilst subjects construed themselves to be better "able to concentrate". These findings are largely in line with those of previous researchers. However, a strong indicative of an increase in "need for approval" provided tentative evidence to suggest that these "positive" psychological changes might not simply have been due to the cumulative effects of regular meditation practice. The increases in "need for approval" might have contributed - either directly

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Summary

by its possible effect on some psychological variables or indirectly via its influence upon a subject's meditation-regularity - toward the meditation-associated psychological changes. It is suggested that the enhanced "need for approval" may have been a reflection of the effects of "Transcendental Meditation-associated social pressures" upon suitably predisposed subjects.

Finally, the subjective concomitants of Transcendental Meditation as practised by the "advanced" meditator group were examined by means of repertory grid techniques. The subjective data were found to provide support for some of the findings of the other experiments discussed above.

3 Comparative Multidisciplinary Investigation

The sixth and major aim of the present study was to investigate the relationship between the hypothetical altered states of consciousness associated with feedback-associated alpha enhancement and Transcendental Meditation by means of a systematic comparative examination of some of their supposed concomitants. It was decided not to compare the states on all the variables examined in the study but only on those variables that met the criterion of having significantly indexed one or both of the states. A failure to adopt this strategy might conceivably have led to a situation where significant differences obtained on relevant indices were swamped by the insignificant effects of irrelevant non-indices.

The two practices were compared in a short-term physiological and behavioural experiment on three variables - alpha abundance, beta abundance and autonomic balance - that had been previously shown to index one or both of the practices. Significant differences emerged between the two techniques as practised by the "successful" alpha feedback group and the "advanced" meditator group on each of these "relevant index" variables. "successful" feedback-associated alpha enhancement was found to be accompanied by more occipital alpha and less occipital beta. In addition, it was found to be followed by a parasympathetic shift in autonomic balance whilst no such effect was found to follow Transcendental Meditation. The practices were then compared simultaneously on these three variables and a significant overall difference was obtained. A similar simultaneous comparison on all short-term variables (i.e., also on criterion "irrelevant non-indices") also produced a significant overall difference between the two practices. On the basis of these findings, it is concluded that feedback-associated alpha enhancement and Transcendental Meditation have important and significant distinguishing parameters, and that, in terms of the present operational definition for hypothetical states of

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consciousness, the data are consistent with the hypothesis that the practices are accompanied by distinct hypothetical altered states of consciousness.

The practices were also compared over the long-term on psychological variables that had previously been shown to alter significantly as a function of at least one of the practices. Groups who practised the two techniques over periods of approximately 6 weeks - the "successful" alpha feedback group and the "regular" novice meditator group - were found to produce very similar psychological changes. "Negative" psychological characteristics tended to be reduced whilst "positive" psychological characteristics tended to be enhanced. The only definite significant difference that emerged between the two groups was with respect to their changes in "need for approval" - with the alpha feedback group decreasing and the meditators increasing. This also turned out to be the variable that best discriminated between the two practices. On the basis of these latter data, it is concluded that although the two practices seemed to be accompanied by highly similar measurable psychological changes, some of the mechanisms underlying these changes seemed to be different. In the case of Transcendental Meditation, social factors appeared to play an important role in raising "need for approval" which, in turn, seemed to have contributed crucially toward the obtained psychological changes. For feedback-associated alpha enhancement on the other hand, there was no evidence to suggest that social factors might have exerted any systematic or measurable effect.

Finally, an attempt was made to compare the short-term subjective concomitants of the two practices by means of a comparative examination of the scores of the "successful" alpha feedback group and the "advanced" meditator group on a "phenomenological repertory grid". Although some significant differences were obtained, the data are open to contradictory interpretations. Because of these problems of interpretation, no conclusions are derived from the subjective data concerning the relationship between the two hypothetical altered states of consciousness.

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1.0 PROBLEMS AND AIMS

The problem areas under examination in the present study may be conveniently considered under three interrelated headings.

1.1 An Experimental Investigation into the Correlates of Feedback-Associated Alpha Enhancement

The phenomenon of enhancing and/or suppressing EEG alpha abundance by the provision to subjects of alpha-contingent feedback has been widely reported (see sections 2.1 to 2.3). For the purpose of evaluating the findings in the area, operant terminology will be adopted (Shapiro & Schwartz, 1972). Within this framework it may be shown that the majority of researchers have attempted to demonstrate one or more of the following three kinds of operant conditioning phenomena:

- (1) An operantly conditioned alpha increase (above a basal level).
- (2) An operantly conditioned alpha decrease (below a basal level).
- (3) Operantly conditioned differential alpha control (i.e., the difference between "enhance" and "suppress" conditions).

Whilst the last two phenomena appear to have been frequently and widely demonstrated (see section 2), acceptable instances of the first phenomenon appear to be far more elusive. Although many researchers have reported having demonstrated the phenomenon, few have managed to satisfy Katkin and Murray's (1968) three minimal criteria for the acceptability of evidence for operant conditioning (see section 2.4).

One of the aims of the present study was to attempt to demonstrate the phenomenon of operant alpha enhancement. A group of subjects were given daily hour-long alpha feedback training sessions over a period of six weeks. On the basis of their success at raising their occipital alpha levels over the longitudinal period, the subjects were assigned to either a "successful" alpha feedback group (comprising the 50% who increased their alpha abundance most) or an "unsuccessful" alpha feedback group. The ability of the "successful" group to demonstrate the phenomenon of operant alpha enhancement was examined by means of a short-term experiment that incorporated both within-subjects and between-subjects designs. That is, it permitted the "successful" group to be compared with the "unsuccessful" group and, at the

same time,/

same time, allowed the "successful" alpha feedback subjects to act as self-controls. Katkin and Murray's (1968) first minimal criterion for the acceptability of evidence for operant alpha enhancement requires, (1) in terms of the within-subjects design, that the "successful" subjects' operant condition alpha level exceed significantly that of their free-operant condition, and (2) in terms of the between-subjects design, that the operant condition alpha level of the "successful" group significantly exceed that of the "unsuccessful" group. Katkin and Murray's second criterion demands that the experimental design permit the comparison of experimental groups with appropriate control groups whilst their third criterion requires that the data be, within reasonable limits, free from obvious alternative explanations. To the extent that the data of the present study meet these criteria, it will be assumed that the phenomenon of operant alpha enhancement had been demonstrated.

With the exception of a number of attempts to measure the subjective correlates of various feedback-associated EEG states (see sections 2.1 and 2.2), very little research has been directed toward an examination of the psychological and physiological concomitants of alpha feedback training. Schwartz, Shaw and Shapiro (1971) reported finding that the mechanisms for alpha control and heart-rate control are independent, a finding consistent with Kamiya's (1962) early observation of an apparent independence between conditioned alpha changes and changes in cardiac activity, respiratory activity, eye-movements and muscle tension. Engstrom, London and Hart (1970a,b) performed a study to examine the relationship between alpha feedback training and hypnotisability and reported finding that feedback training to enhance alpha duration significantly increased hypnotisability. Unfortunately, although their findings appear to be acceptable, they are consistent with a number of alternative interpretations (see section 2.3). It has also been widely contended, largely on the basis of alpha feedback's assumed similarity to meditation (see section 4), that its regular practice is accompanied by a host of beneficial (and even psychotherapeutic) psychophysiological changes. However, no direct examination of these claims has been reported.

A second major aim of the present study was to determine the physiological, behavioural and psychological correlates of "successful" feedback training for alpha enhancement. Employing, once again, a short-term experiment incorporating both within- and between-subjects designs, the influence of feedback-associated alpha enhancement on other occipital EEG frequencies and on

heart-rate/

heart-rate was examined. In addition, an attempt was made to determine its subsequent effect on autonomic balance measures and on performance on reaction-time and short-term memory/perceptual speed tasks. Over the long-term, the influence of regular "successful" feedback-associated alpha enhancement was examined by comparing the pre- and post-feedback training psychological test scores of the "successful" and "unsuccessful" alpha feedback groups. The psychological dimensions investigated included "hypnotic susceptibility", "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "tension", construed "ideal-self", construed "frustration-tolerance", construed "empathy", construed "ability to concentrate", construed "involvement", construed "happiness", construed "warmth", construed "passivity", construed "withdrawal", construed "creativity", construed "optimism", construed "confidence" and construed "sensitivity".

1.2 An Experimental Investigation into the Correlates of Transcendental Meditation

Wallace (1970b) has proposed that the practice of Transcendental Meditation brings about a fourth major state of consciousness - one that is physiologically distinguishable from the accepted trio of waking, sleeping and dreaming. The physiological activity that has been reported by researchers to index this state (see section 3.1) has prompted Wallace, Benson and Wilson (1971) to term it a "wakeful hypometabolic state" characterised by a parasympathetic shift in autonomic balance.

Researchers have reported Transcendental Meditation to be accompanied by reliable and progressive changes in EEG activity. With a deepening of the meditative state, alpha abundance appears to increase whilst the average alpha frequency tends to decrease. Finally, during the deepest stages of meditation, theta and possibly even beta may be observed. Furthermore, the focus of the slow-wave EEG changes seems to have a tendency to migrate from the occipital to the frontal EEG channels during the course of meditation. Most of the reported EEG correlates of Transcendental Meditation refer therefore to frontal EEG activity. Nevertheless, although there is less consensus concerning possible occipital EEG changes during meditation, the available evidence points tentatively toward there being either no significant changes or toward there being a decrease in occipital alpha accompanied by an increase in occipital beta activity (see section 3.1.1).

The third major aim of the present study was to examine the occipital EEG correlates of Transcendental Meditation. Using a within-subjects experimental design, the occipital EEG correlates of a group of experienced teachers of Transcendental Meditation were examined across experimental sessions each comprising a pre-meditation rest condition, a meditation condition and a post-meditation rest condition. The EEG data were automatically converted to numerical form, normalised - using the pre-meditation rest condition data as base (see section 5.5) - and subjected to statistical analysis. The pre-meditation rest condition base represented the control condition against which the meditation-associated EEG changes or the post-meditation rest condition EEG changes could be related.

The Transcendental Meditative state, in comparison to the waking state, appears also to be accompanied by a decreased respiratory-rate (see section 3.1.3), decreased frequency of spontaneous GSRs and a marked increase in skin-resistance (see section 3.1.5), decreased cardiac output, oxygen consumption and carbon dioxide elimination, decreased arterial blood pH levels (see section 3.1.6) and markedly diminished blood lactate concentration (see section 3.1.7). In addition, small increases in forehead and arm skin temperature (see section 3.1.8) as well as slight decreases in EMG activity (see section 3.1.10) are frequently described. On the other hand, no consistent or significant changes in blood pressure (see section 3.1.2), respiratory gas exchange quotient, arterial pO_2 , arterial pCO_2 (see section 3.1.6) or EOG activity (see section 3.1.9) appear to be associated with the practice of Transcendental Meditation. The position with regard to the influence of meditation on heart-rate is contradictory (see section 3.1.4). On the more molar behavioural and psychological levels, Transcendental Meditation has been reported to be associated with enhanced perceptual-motor performance (see section 3.2.1), increased learning ability and intelligence (see section 3.2.3) and heightened perceptual performance (see section 3.2.2). These latter findings appear, however, to lack acceptable scientific support.

The fourth major aim of the study was to investigate a number of the short-term physiological and behavioural concomitants of Transcendental Meditation. Employing the same "advanced" meditator group and the same experimental design as for the EEG investigation, the heart-rate correlates of meditation were examined. In addition, in an attempt to determine the effects of meditation upon waking autonomic balance levels, pre- and post-meditation

autonomic balance measures were obtained. It should be noted that this strategy was not designed to establish changes in autonomic balance during actual meditation. Similarly, the influence of meditation upon subjects' waking performance on reaction-time and on short-term memory/perceptual speed tasks was examined by obtaining pre- and post-meditation performance scores on these tasks.

The reported relationship between the long-term practice of Transcendental Meditation and psychological changes of the type measured by pencil-and-paper tests appears to be overwhelmingly reliable. Researchers have linked the practice, without exception, to "positive" psychological changes. Amongst the most frequently reported psychological concomitants are increased "self-actualisation", increased "happiness", improved "inter-personal relationships" and decreased "anxiety", decreased "neuroticism", decreased "aggression" and decreased "tension" (see section 3.2.4). Since these "positive" correlates of Transcendental Meditation have been established by different investigators, using different psychological instruments and experimental design, their reliability seems to be acceptably high. Unfortunately, at present there are two contradictory sets of interpretations for the above findings. The more widely held view is that "the regular cumulative practice of meditation" is the crucial factor responsible for the meditation-associated "positive" psychological changes. More recently, however, some researchers (Otis, 1973; Ballou, 1973) have pointed to factors that converge around the time that subjects are first initiated into Transcendental Meditation to be of central importance, thus rejecting the view that meditation has a cumulative effect.

The fifth major aim of the study was thus to explore the psychological concomitants of long-term regular meditation practice and to attempt to determine the role, if any, of factors related to changes in "need for approval" in bringing about measurable psychological changes.

A group of novice meditators were measured on a number of psychological dimensions prior to their learning Transcendental Meditation and again after having had 6 weeks experience. The group was divided into a "regular" and an "irregular" novice meditator group on the basis of their meditation regularity over the period and compared. The psychological dimensions employed included all those outlined for the alpha feedback investigation (see section 1.1) except for "hypnotic susceptibility". This strategy, it

was hoped/

was hoped, would provide evidence concerning not only the two contradictory interpretations for meditation-associated psychological changes but also for the mechanisms that have been proposed to account for the meditation-associated psychophysiological changes (see section 3.3).

1.3 An Experimental Investigation into the relationship between the Feedback-Associated Alpha State and the Transcendental Meditative State

It has been widely assumed that the practices of Transcendental Meditation and EEG feedback for alpha enhancement are associated with similar or even identical psychophysiological concomitants. These assumed similarities have then been held to support the notion of identity or near-identity with respect to the altered states of consciousness associated with the practices (see section 4).

It is recognised that the strategy of conceptualising these psychophysiological conditions in terms of states of consciousness is of debatable usefulness. "Consciousness" is a term that has been assigned a different meaning by many of those who have used it and consequently a consideration of the meta-theoretical implications of employing the term is beyond the scope of the present study. Instead, a given state of consciousness is operationally defined is a hypothetical construct which may be indexed, albeit in an imperfect way, by relevant data drawn from many levels of analysis and derived by different methodological operations. It is assumed that this hypothetical "internal state" cannot be fully indexed by the data of any one operation (eg., the EEG), but that an inference is built up on the basis of many intersecting and overlapping observations (see section 4.3). This may be seen to be analogous to the historical position of the electron in physics or the gene in biology - both have been postulated entities, or inferred hypothetical constructs.

Previous writers have frequently suggested a close relationship to exist between the two hypothetical altered states of consciousness on the basis of apparent similarities with respect to their EEG and subjective correlates. Comparisons were undoubtedly complicated by the fact, however, that the data used for these comparisons were derived by different researchers and by different research methodologies (for alpha feedback and meditation respectively). For example, feedback for alpha enhancement and Transcendental Medi-

tation have/

tation have frequently been described as having similar EEG correlates - notably, an elevation in alpha abundance. However, since the alpha feedback researchers have invariably concentrated upon the enhancement of occipital alpha (see section 2) whilst Transcendental Meditation appears to be accompanied by a more frontally-restricted alpha change (see sections 1.2 & 3.1.1), serious doubt is raised concerning the validity of employing these data for comparative purposes. No published study has attempted to systematically compare the EEG correlates of the two practices using the same EEG placements and experimental techniques.

Possibly even more suspect has been the tendency of previous writers to base their conclusions concerning identity or near-identity of the two states upon insufficient data - invariably merely EEG and/or subjective data alone. It has been recently convincingly demonstrated that neither subjective data (see section 4.1) nor EEG data (see section 4.2) are, by themselves, adequate indices for defining hypothetical altered states. Stoyva and Kamiya (1968) and Stoyva (1970) have suggested instead that by the simultaneous use of a number of these imperfect indices, the construct validity of the hypothetical altered states of consciousness may be enhanced and thus provide evidence concerning their relationship. By way of analogy, although neither EEG activity nor REMs (alone) are perfect criteria for the presence of the hypothetical dream state, their use in combination enhances considerably the construct validity of this hypothetical "internal" state.

The sixth and major aim of the present study was to investigate the relationship between the two hypothetical altered states of consciousness by means of a systematic comparative examination of some of their supposed concomitants. It was assumed that a failure to discriminate between the two practices using the indices selected (see below) would constitute supportive evidence for the hypothesis of Transcendental Meditative state/feedback-associated alpha state identity or near-identity. The hypothesis would be undermined on the other hand, to the extent that differences were found to materialise. A rejection of the hypothesis would imply that the two practices are accompanied by distinct hypothetical altered states of consciousness. The question of whether the distinction is of a qualitative or merely a quantitative nature would remain contentious.

The two states were not compared across all the variables examined in the study but merely on those variables that were found (in previous sections of

the study/

the study - see sections 1.1 & 1.2) to index significantly one or both of the states. Thus, for example, should a particular variable be found to index neither state, it was excluded from the comparative investigation. A failure to adopt this strategy could conceivably have led to a position where significant differences obtained on "relevant indices" were swamped by the insignificant effects obtained on "irrelevant non-indices". On the other hand, it is recognised that this procedure might have resulted in the exclusion of variables which would have discriminated between the two states.

The relationship between the two hypothetical states was investigated in two separate studies. The first involved a short-term comparative examination of the "successful" alpha feedback group (see section 1.1) and the "advanced" meditator group. The variables over which the groups might potentially have been compared (see above) included the following: EEG (i.e., four frequency bands) and heart-rate correlates and the influence of their respective techniques upon waking autonomic balance levels, on reaction-time performance and on short-term memory/perceptual speed performance. The subjective concomitants of the two practices were also compared by means of a Phenomenological Repertory Grid (see appendix K). The second study comprised a longitudinal comparative investigation into the psychological correlates of the two states. The pre- and post-training scores (separated by about six weeks) of the "successful" alpha feedback group (see section 1.1) and the "regular" novice meditator group (see section 1.2) on a number of selected psychological dimensions (see above) were examined. The psychological dimensions from which the selection was made corresponded to those outlined in section 1.2.

2.0 ALPHA FEEDBACK LITERATURE SURVEY

Joe Kamiya is widely accredited as the founder of the study of EEG feedback. He started studying the phenomenon as early as the late 1950's but it was not until 1962 (Kamiya, 1962) that his work was first published in any definitive form. By the end of the decade his work had become widely known and he was joined in the field by a number of other researchers such as Brown (1970, 1971), Green (1971), Mulholland (1968), Murphy (1969) and Stoyva (1970) who also made notable and pioneering contributions. Gaerner (1971) suggests in fact that a number of persons separately and more or less simultaneously discovered the phenomenon - that it was another example of "the simultaneous discovery of an idea whose time had come."

Prior to this discovery of the ability to manipulate the EEG by means of feedback technology, a number of studies had reported the amenability of the EEG to the techniques of classical conditioning. These studies did not attempt so much to condition the appearance of alpha, but rather the desynchronisation or disappearance of alpha - the alpha blocking response. Although Knott (1941), Gastaut et al (1957) and Mundy-Castle (1958) failed to obtain clear evidence for conditioning, Loomis, Harvey and Hobart (1936), Jasper and Cruikshank (1937), Travis and Egan (1938), Jasper and Shagass (1941a, 1941b), Shagass (1942), Shagass and Johnson (1943), Stern, Das, Anderson, Biddy and Surphlis (1961) and Albino and Burnard (1964) obtained positive results. This research essentially involved the repeated pairing of a previously neutral stimulus, such as a tone, with an unconditioned alpha blocking stimulus to determine whether or not the previously neutral stimulus could acquire alpha blocking properties. Cruikshank (1937) also reported the classical conditioning of the alpha blocking response to a constant time interval - a phenomenon termed "time conditioning" by Walter (1938). Although classical conditioning of the alpha blocking response has not been conclusively demonstrated, the general view is that the evidence points tentatively in favour of the phenomenon (Albino & Burnard, 1964).

2.1 Kamiya's Pioneering Work: Kamiya's early work on alpha feedback, or as he usually terms it, alpha conditioning, may conveniently be divided into three distinct developmental phases. The first phase involved his investigations into the possibility of human beings discriminating between EEG events. This work was important in that the ability of subjects to discriminate between different EEG events by means of their distinct "private stimulus/.....

stimulus concomitants" was a necessary pre-condition for the possible altering of these events by means of feedback technology or operant conditioning. Slucki, Adam and Porter (1965) had similarly first to demonstrate that animals had the ability to discriminate between internal visceral events - a necessary pre-condition for autonomic response learning - before Neal Miller (1968) attempted to operantly condition these responses.

In these discrimination experiments, Kamiya (1962, 1968, 1969) first instructed his subjects to guess which of two brain wave events, labelled A (alpha) and B (beta), they were producing when he sounded a bell. He then informed them, on the basis of their EEG records, whether their guesses were correct or not. After about three hours of this simple discrimination training most subjects were able to correctly respond at well above the 50% chance level and one subject achieved nearly 100% correct responses.

Having established that subjects had the ability to discriminate between discrete EEG events, Kamiya next attempted to determine whether this prior discrimination training afforded them any control over their EEGs. The subjects were asked to produce brain wave event A on one signal and brain wave event B on another and the results indicated that after they were given this prior discrimination training they were, indeed, able to voluntarily control these EEG wave patterns.

The third and final developmental phase of Kamiya's work involved his investigation into the possibility of subjects gaining direct control over their EEG events without having to undergo prior discrimination training. It was at this stage that the typical biofeedback or operant conditioning methodology was first used. This essentially involved criterion level alpha being followed by tonal reinforcement while non-alpha or below-criterion alpha remained unreinforced. Once more, Kamiya (1968, 1969) obtained positive results, and it appeared, indeed, that subjects could gain quite subtle control over their EEG activity by means of this feedback technique.

All of the studies to be reviewed below are at this developmental stage, that is, they employed feedback or operant methodology in their attempts to manipulate the EEG. Their findings are consequently evaluated critically within an operant framework. Specifically, Katkin and Murray's (1968)

proposed/

proposed three minimal criteria for the acceptability of evidence for operant conditioning are applied to each of the studies under review. The criteria demand of a study purporting to demonstrate an operantly conditioned change that:

- (1) there should be some demonstration that the response being reinforced shows an increase in frequency, or amplitude, or probability over the level shown in the free-operant period;
- (2) the experimental design should allow comparisons between experimental groups and appropriate control groups;
- (3) the data should be, within reasonable limits, free of obvious alternative explanations, such as those proposed by Skinner (1938) (see Appendix L).

Kamiya (1969) performed an experiment in which subjects were required, by means of alpha feedback, to directly suppress their alpha rhythms. The task was readily accomplished by six out of the seven subjects. A systematic decrease in alpha as a function of training trials was found. The subjects were able to describe, furthermore, the "private stimulus concomitants" of this low-alpha state. There was general agreement in describing it as a state of heightened visualisation. In fact, when the one unsuccessful subject was given this insight, he too achieved successful alpha suppression.

Kamiya next performed a study, which he has since replicated several times, aimed at establishing whether the decrease in alpha obtained in the above "suppression-only" feedback study was, indeed, a conditioned decrease or whether the effect was simply functionally related to the number of experimental trials. An experimental design employing alternating blocks of three kinds of experimental conditions - "enhance alpha", "rest" and "suppress alpha" - was used. It was found that the "suppress alpha" conditions produced the expected decrease in alpha as a function of reinforcement trials while the "enhance alpha" conditions produced the expected upward trend in percentage time alpha. These findings strongly suggest that the subjects learned to respond differentially (or acquired operant differential control) across the two kinds of experimental condition - "enhance alpha" and "suppress alpha". In order to establish whether significant alpha enhancement or significant alpha suppression had been learnt, however, it is necessary to relate these apparent operantly conditioned deviations in alpha to a baseline alpha level (see above). Kamiya, in fact, intended the "rest conditions" interspaced between the operant conditions to serve as basal or free-operant conditions.

However,/

However, an unexpected experimental finding negated this possibility. Instead of the percentage time alpha remaining constant in the "rest" conditions, as would have been expected had it been really no more than a simple basal condition, a strong increase in alpha as a function of the number of rest conditions was found; an increase that was slightly greater even than that found over the "enhance alpha" conditions. Kamiya hypothesised that this was due to the subjects having acquired a "preferred mode of waiting" as a result of their exposure to the alpha feedback experimental procedure. The preferred mode was, of course, the high alpha state. Kamiya presented two sets of evidence in support of this interpretation. The first was that subjects learned to prefer to rest in the high alpha mode simply because it is a state generally described as being pleasant and desirable. The second set of evidence came from additional studies that showed that when subjects were given only "suppression" training, their "baseline" alpha levels tend to decline. That is, they continued to do in the basal condition what they had been trained to do in the operant condition. On the other hand, when given training for both enhancement and suppression, they preferred enhancement and alpha baselines tended to rise.

Kamiya's (1969) operant alpha increase fails to satisfy Katkin and Murray's (1968) first minimal criterion for the acceptability of evidence for operant conditioning (see above). That is, that the response being reinforced should show an increase over its level in the free-operant period. Kamiya's percentage time alpha in the "enhance alpha" conditions clearly fails to exceed that in the so-called baseline conditions. The "suppress alpha" conditions on the other hand, do meet this criterion and the likelihood of a conditioned decrease in alpha appears much greater. Crider, Schwartz and Shnidman (1969) and Davidson and Krippner (1971) have supported Kamiya's (1969) view that the basal alpha levels can change as a result of the operant training, implying essentially that this changed "basal" level is inconsistent with Katkin and Murray's definition of a baseline. That is, whilst Kamiya (1969), Crider, et al (1969) and Davidson and Krippner (1971) claim that Kamiya's "baseline" condition is affected by the experimental independent variables (i.e., the feedback given during the operant conditions), Katkin and Murray require that the free-operant condition be subject to all the influences affecting the operant conditions except for the independent variables (i.e., the actual response-contingent reinforcement). Thus, should this view be accepted, it would follow that Katkin and Murray's first

criterion cannot be legitimately applied to this data. However, in supporting a view expressed by Grice and Barber (1966) concerning a potential weakness inherent in within-subjects experimental designs, Spanos and Chaves (1970) said that a "... statistical design that compares the effects of two or more treatments administered to the same subjects may validly be employed to draw conclusions about the independent effects of these treatments only if it can be assumed that the treatments do not affect one another." It follows therefore that should Kamiya (1969), Crider et al (1969) and Davidson and Krippner's (1971) view be accepted, then it would follow that the variables influencing the free-operant and the operant conditions are sufficiently confounded to invalidate any conclusions made concerning possible operant alpha enhancement. In summary therefore, a rigorous application of Katkin and Murray's (1968) first criterion leads one to the rejection of Kamiya's (1969) assertion of having operantly conditioned an alpha increase. The rejection of the applicability of this criterion on the basis of the arguments put forward by Crider et al (1969) and Davidson and Krippner (1971) however, leads one logically to the position where it is shown that the variables influencing the free-operant and the operant conditions had been sufficiently confounded to rule out the possibility of drawing legitimate conclusions concerning possible operant alpha enhancement.

Davidson and Krippner (1971) attempted not only to argue against the applicability of Katkin and Murray's first criterion to Kamiya's data, but also presented evidence which they felt would have allowed for the acceptance of Kamiya's data in terms of this criterion. They wrote that; "It should be noted that the alpha during the generation trials was of a higher amplitude than the alpha present in the baseline periods." However, since it was an increase in percentage time alpha and not necessarily an increase in alpha amplitude that Kamiya attempted to operantly condition, this evidence is quite irrelevant.

Katkin and Murray's (1968) second criterion was satisfied by Kamiya's (1969) experimental design. That is, adequate control procedures were employed. The differential operant alpha control that was demonstrated obviously met the minimal control standards since this type of conditioning, of necessity, incorporates a bidirectional control (Black, 1972). Adequate control for the demonstration of operant alpha enhancement and suppression was provided by the within-subjects interspacing of operant and free-operant conditions.

The data upon which Kamiya (1969) bases his claim of having operantly conditioned an increase in alpha is open to a number of alternative interpretations. It fails thus to meet the third of Katkin and Murray's (1968) criteria. Since no period of adaptation to the experimental situation was reported by Kamiya, it appears probable that subjects learned increasingly to relax in, habituate to, and to pay less attention in the experimental situation and that the increases in alpha as a function of time was mediated by changes in these variables. This alternative explanation is supported by the findings of Peper (1970) who found that subjects produce more alpha when instructed to "not pay attention" than when instructed to "pay attention". Lynch and Paskewitz (1971) similarly wrote that; "Alpha activity occurs in the feedback situation when an individual ceases to pay attention to any of a number of stimuli which normally block this activity. These stimuli may be cognitive, somatic, emotional or anything, in fact, which will lead to alpha blocking." Since the possible influence of these factors in raising alpha in the feedback situation is discussed at length in section 2.4.3, no further evidence in support of this plausible alternative explanation will be presented here. It nevertheless appears quite reasonable to conclude that this alternative interpretation is capable of accounting for, wholly or in part, the alpha increase found by Kamiya (1969) to accompany both his "enhance alpha" and his "rest" conditions.

Skinner's (1938) description of four ways in which apparent autonomic response conditioning may occur (see Appendix L) may apply equally to the apparent operant alpha conditioning - both to increases and to decreases in alpha. That is, the apparently conditioned alpha changes might be the result, not of direct operant conditioning, but of operantly conditioned alterations in somatic or cognitive responses which mediate the apparently conditioned EEG changes. This alternative explanation for apparent direct operant alpha conditioning is discussed at length in section 2.4.3.

In summary therefore, it is concluded that whilst Kamiya (1969) appeared to satisfactorily demonstrate both operant alpha suppression and differential operant alpha control, he did not succeed in demonstrating conclusively the phenomenon of operant alpha enhancement.

Kamiya (1969) attempted also to establish whether specific subjective reports were associated with the high and low alpha EEGs produced by his subjects. There was general agreement in describing the high alpha state as an

uncritical pleasant state characterised by mental, if not physical, relaxation. The non-alpha state on the other hand was generally associated with sustained visualisation and no particular reports of pleasantness.

A rather tentative description of people who performed particularly well in the alpha feedback situation was also offered by Kamiya. People loosely described as "meditators", people with a history of introspection, those who frequently used words like images, dreams, wants and feelings, also psychotherapists of the type who lay great store by "growth" techniques, people who feel at ease in close interpersonal relationships and those who are particularly good at intuitively "sensing" the feelings of others, were all tentatively described as "good feedback subjects".

The influence of these tentative descriptions, as well as of the reported subjective associations of the high alpha state, on the course of future research in the field cannot be over-estimated. This data formed the starting point for most of the divergent research trends in the area. The implied relationship between feedback-associated high alpha states and meditative states is clear. The ramifications of this implied relationship are discussed at length in section 4. Kamiya's (1969) description of the good alpha subject appears also, however, to be strikingly similar to both Hilgard's (1965, 1969) and Ericksen's (1967) description of the good hypnotic subject as well as to Bakan (1971) and Day's (1967) description of a predominantly left CLEM (Conjugate-Lateral Eye Movement) looker. Hilgard (1965) described the good hypnotic subject as one who "... has rich subjective experiences ..., one who is interested in the life of the mind ..., and who accepts impulses from within." Nideffer (1973) similarly cites Ericksen's (1967) description of the good hypnotic subject to correspond almost exactly to Kamiya's description of a good alpha feedback subject. This has prompted much research into the possible relationship between alpha feedback training and hypnotisability (see section 2.3). Bakan's (1971) description of the predominantly left-CLEM subject as subjective, passive, relaxed, preverbal and parasympathetic, has similarly led to research being directed into possible CLEM/alpha feedback relationships (Bakan & Svorad, 1969; Strayer, in Bakan, 1971; Krummeck, 1973).

2.2 Subsequent EEG Feedback Research: Hart (1967) attempted to replicate and extend the findings of Kamiya (1962, 1968, 1969). He employed two alpha feedback experimental groups as well as a non-feedback control group.

The first/

The first experimental group received both within-session alpha-contingent tonal reinforcement as well as post-session verbal reinforcement to inform them as to their level of success during the feedback sessions. The second experimental group received only the within-session alpha feedback. Finally, the control group received no within-session alpha feedback but did receive post-session verbal feedback. The results were in the expected direction with the first experimental group achieving greater alpha increases than the second, who in turn achieved greater alpha increases than the control group. These differences, however, failed to reach significance.

Although Hart's (1967) experimental design, by incorporating a non-feedback control group, partially¹ satisfies Katkin and Murray's (1968) second minimal criterion, the results fail to meet the first criterion. That is, the operant alpha levels (of the experimental groups) failed to rise significantly above the free-operant levels (of the control group). Nevertheless, the results do at least tentatively suggest the efficacy of both alpha feedback and verbal feedback in raising alpha levels.

Green, Green and Walters (1969, 1970) conducted a series of experiments into the psychological and physiological effects of autogenic training (Schultz & Luthe, 1959) and biofeedback training. It is the findings of the latter studies that are of relevance here even though they differed methodologically in a number of important respects from Kamiya's work (Kamiya, 1969). For instance, instead of the subjects being given tonal feedback in an eyes-closed condition, they were given visual feedback in an eyes-open condition. Second, in these experiments an attempt was made to condition two additional physiological functions simultaneously with the alpha rhythm - a reduction in forearm EMG (electromyograph) activity and an increase in the temperature of the hand. Any comparison therefore between the findings of these experiments and those of the other studies reviewed will necessarily have to be tentative. Using 5 subjects, Green, Green and Walters (1969, 1970) reported that they obtained an increase in percentage time alpha within five feedback training sessions. In addition they reported that the initially "high alpha producers" increased their alpha levels more than did the initially "low alpha producers."

Unfortunately/

¹ The second criterion was only partially met since a non-reinforcement control group is not generally considered to be as effective as a yoked control group.

Unfortunately, the study on which these conclusions were based failed not only to offer any statistical confirmation but failed even to incorporate minimal control procedures. For example, neither a within-subjects bi-directional alpha conditioning control procedure nor even a between-subjects non-reinforcement control group was employed. The research thus clearly fails to meet the minimal requirements of Katkin and Murray's (1968) second criterion. Therefore, even though, according to Davidson and Krippner (1971) some of the results - some subjects were able to emit 100% alpha in ten second epochs while speaking with their eyes open - are very unlikely to be simply a function of non-feedback resting, their total neglect of appropriate control procedures negates the possibility of drawing anything except the most tentative of conclusions.

Nowlis and Kamiya (1970) performed an experiment to investigate feedback-induced alpha control and associated mental activity. After being allowed two minutes in which to adapt to the experimental situation, the baseline alpha scores of the 26 experimental subjects were determined. This was followed by a 15-minute feedback period during which free practise at alpha control was permitted. Some subjects were given auditory feedback in an eyes-closed condition whilst others received visual feedback in an eyes-open condition. Finally, they were given a 2-minute test trial during which they attempted to produce as much alpha as possible and another 2-minute test trial during which they attempted to produce as little alpha as possible. The results indicated, not only a significant difference between the final generation and suppression trials, but also a significant difference between the generation ("enhance alpha") trials and the basal trials on the one hand and the suppression trials and the basal trials on the other. It was additionally found that those subjects who were successful at controlling their alpha were able spontaneously to describe their EEG-associated mental activity. Relaxation, non-visual focussing and "letting go" were reported to be associated with alpha. These subjective-report findings are essentially the same as those found by Kamiya (1962, 1968, 1969) and by Green, Green and Walters (1969, 1970).

This study, like that of Kamiya (1969), appears to have conclusively demonstrated the phenomenon of operant differential alpha control (i.e., alpha differences across "enhance alpha" and "suppress alpha" conditions). This experimental condition of necessity contains its own bidirectional operant

conditioning/

conditioning control. However, unlike Kamiya's earlier study, the results of this study appear to meet Katkin and Murray's (1968) first criterion for both alpha enhancement and alpha suppression. (It was concluded that the earlier study had failed to demonstrate operant alpha enhancement.) That is, both the conditioned alpha decreases and the conditioned alpha increases were significantly different from a free-operant or basal condition. However, Nowlis and Kamiya (1970) failed to employ adequate control procedures, thus failing to satisfy Katkin and Murray's second criterion. It appears highly probable that after being allowed only a 2-minute adaptation period, subjects' basal alpha levels were still greatly depressed by such factors as apprehensions about the forthcoming experiment, the novelty of the experimental situation and other similar influences (Lynch & Paskewitz, 1971). All or part of the alpha increase could conceivably be accounted for in terms of a decrease in the influence (or orienting value) of these factors as a function of time spent in the experimental situation. There thus appears to be an obvious alternative explanation for the apparent operant alpha enhancement (but not for the operant alpha suppression). The findings with regard to the alpha increase consequently fail to satisfy the requirements of Katkin and Murray's third criterion for operant conditioning.

Nowlis and Kamiya (1970) appear to have conclusively demonstrated both differential operant alpha control and operant alpha suppression. The phenomenon of operant alpha enhancement was, however, not satisfactorily demonstrated. The possibility of these apparently conditioned EEG changes being accounted for in terms of mediation is discussed fully in section 2.4.3.

Barbara Brown (1970) investigated aspects of consciousness associated with EEG alpha activity by means of a feedback procedure that provided subjects with light feedback in an eyes-open condition. A further important methodological distinction between this study and those of Kamiya (1968, 1969) and Hart (1967) lay in the fact that Brown's (1970) light feedback incorporated both digital and analog information whereas the tonal feedback of these other studies contained only digital information - tone "on" for alpha and tone "off" for non-alpha. The presence of Brown's light signal was a function of alpha presence (i.e., the digital information component) whilst the intensity of the light signal was functionally related to the alpha amplitude (i.e., the analog component). Comparisons therefore between the findings of

this/

this study and those of Kamiya (1968, 1969) and Hart (1967) will necessarily have to be somewhat tentative. Each experimental practice session comprised a 10- to 15-minute relaxation or adaptation period followed by a 5-minute eyes-open and a 5-minute eyes-closed non-feedback condition. This was followed by 5 alternating blocks of 10-minute "enhance alpha" (feedback) and 3-minute "rest" (basal) conditions. The feedback and the rest conditions were all eyes-open conditions. Twenty-three subjects completed two or more experimental practice sessions and 10 completed four or more sessions. The results, unlike those of Kamiya (1969), indicated that subjects produced significantly more alpha during the feedback conditions than during the interspaced rest conditions. Subjective reports strongly implicated a narrowing of perceptual awareness, drifting and floating sensations and an apparent shortening of time with absolute abundance of alpha. Discrimination, that is, experimental over rest condition percentage time alpha levels, tended to be more closely associated with "maintaining perceptual awareness". In all other respects the subjective reports relating to "discrimination" were the same as those associated with absolute alpha abundance. These subjective reports are essentially in agreement with those reported by Kamiya (1968, 1969), Green, Green and Walters (1969, 1970) and Nowlis and Kamiya (1970).

Brown's (1970) findings clearly meet Katkin and Murray's (1968) first minimal criterion. That is, the percentage time alpha was significantly higher in the operant enhance alpha conditions than in the free-operant rest conditions. The second criterion also appears to be adequately satisfied since the interspacing of operant and free-operant conditions permitted each subject to act as a self-control. Finally, the third minimal criterion, that the data be free from an obvious alternative explanation, appears also to be adequately satisfied should the question of possible explanation in terms of mediational mechanisms be left until later (see section 2.4.3). Brown (1970)¹ appears therefore to have, indeed, demonstrated the phenomenon of operant alpha enhancement. No attempt was made to demonstrate operant alpha suppression or differential alpha control.

Whereas Kamiya's (1969) apparent operant alpha increase was more than offset by alpha increases in the free-operant periods, Brown (1970) appears to have achieved a conditioned alpha increase that was significantly greater than any increase in her baseline conditions. It should be pointed out that Kamiya's (1969) "preferred mode" phenomenon (i.e., an increase in basal alpha as a

function/

¹ Brown (1970) does not, in fact, hold the view that feedback-associated EEG changes are brought about by operant conditioning.

function of the number of conditions) was also seen in Brown's study. However, not only was the effect less strong but the alpha increase in the operant conditions was also significantly greater. This apparent discrepancy between the findings of Brown (1970) and Kamiya (1969) demands some comment. There were at least four important methodological differences between the studies which might have contributed toward these different findings. Firstly, since Brown's (1970) subjects were allowed a far longer adaptation period prior to the determination of experimental data, their basal levels were probably less depressed by alpha-blocking factors when the experimental data were recorded. It follows therefore that whereas Kamiya's (1969) subjects' basal alpha levels increased sharply as a function of increasing adaptation to the experimental situation, Brown's (1970) already partially-adapted subjects showed a less dramatic increase. Secondly, Brown's feedback signal provided more information per unit time and may therefore have been a more potent reinforcer. Thirdly, since Brown's subjects were given feedback in an eyes-open condition whilst Kamiya's (1969) subjects were given theirs in an eyes-closed condition, it appears probable that the former subjects were initially subject to more alpha blocking influences, leaving a greater scope for alpha enhancement as they learned to inhibit the influence of these factors. Finally, whereas Kamiya's subjects were required to learn to both increase and decrease their alpha levels, Brown's (1970) subjects faced the more limited task of simply having to learn alpha enhancement.

Barbara Brown (1971) summarised the findings of a number of experiments directed toward an examination of the interrelationships between 3 EEG frequencies - beta, alpha and theta - 3 colours - red, blue and green - and subjective thoughts and feelings. Feedback, represented by differently coloured lights, informed naive subjects which EEG frequency they were emitting and they were requested to identify associated subjective activity. Since possible feedback-associated EEG changes were secondary to the major aims of the study, its relevance within the present review is limited to its findings with regard to EEG frequency/subjective-report relationships. Alpha was found to be significantly related to the following descriptors: peaceful, calm, pleasant, at-ease, neutral, illusion, dreamlike, mysterious, uncertainty, contemplative, association of ideas, transcendental thinking, remembering, drowsy, tired and sluggish. Beta was significantly associated with angry, aggravated, irritated, impatient, unhappy, troubled, frustrated, touchy, shaky, investigative and "feel-a-void-inside". Only "vacillating" could be

significantly/

significantly related to theta. In addition, it was found that many of the descriptors associated with alpha were also common to the colours blue and green whereas beta and the colour red frequently shared the same descriptors. These results are essentially in agreement with the EEG frequency/subjective-report associations found by Kamiya (1968, 1969), Green, Green and Walters (1969, 1970), Nowlis and Kamiya (1970) and Brown (1970) but greatly extends these earlier findings.

An important inference to be drawn from Brown's (1971) findings appears to be that subjective-report/physiological-parameter relationships derived by means of biofeedback techniques may potentially be contaminated by pre-existing subjective biases toward the feedback signal. Thus for example, alpha indicated by a red feedback signal is likely to elicit somewhat different subjective associations than alpha indicated by a blue or green light. It even seems possible that differences in the frequency of reinforcement tones could exert contaminating influences and thus account for the minor discrepancies found between investigators.

Peper and Mulholland (1970) attempted by means of tonal feedback to increase and decrease the percentage time alpha of 21 subjects in an eyes-closed condition. EEG-associated subjective reports were also examined. Each practice session consisted first of a 2-minute eyes-closed and a 2-minute eyes-open trial without feedback in order to establish alpha baselines. This was followed by 10 alternating 2-minute "On" or enhance alpha trials and 2-minute "Off" or suppress alpha trials. Finally, one "On" and one "Off" trial without feedback followed. The results indicated that the subjects learned to significantly decrease their "Off" alpha levels below that of their baselines. However, no significant increase in alpha over the basal levels was found in the "On" trials. Finally, the expected significant difference in alpha between the "On" and the "Off" trials was found but this difference failed to increase significantly as a function of additional training. The authors reported that the initially high alpha subjects associated "relaxation" with alpha whereas the initially low alpha subjects tended to implicate "tenseness" with alpha. The former finding is essentially in agreement with the findings of all the studies thus far reviewed (Kamiya 1968, 1969; Green, Green and Walters, 1969, 1970; Nowlis and Kamiya, 1970 and Brown, 1970, 1971) whereas the latter finding is contradictory.

The alpha decrease in the "Off" trials, but not the alpha increase in the

"On"/

"On" trials, was significantly different from baseline alpha levels; thus the former condition but not the latter satisfies Katkin and Murray's (1968) first criterion. Although this study did not use a control group or even an interspaced self-control condition, thus failing to meet Katkin and Murray's second criterion, this merely negates their conclusion of having demonstrated operant alpha enhancement but not their conclusion that operant alpha suppression had been demonstrated. This is because, although alpha is thought to increase simply as a function of increasing adaptation (or non-orienting) in a feedback situation (Lynch and Paskewitz, 1971), no mechanism has been suggested, other than by feedback itself, whereby alpha is reduced in the feedback situation. It may thus be valid to conclude that Peper and Mulholland (1970) succeeded in demonstrating operant alpha suppression but not operant alpha enhancement. The question regarding the possibility of these conditioned effects being mediated is deferred to section 2.4.3.

Peper and Mulholland's (1970) findings appear to differ in one very important respect from those of Kamiya (1968, 1969), Hart (1971), Green, Green and Walters (1969, 1970), Nowlis and Kamiya (1970) and Brown (1970). Whereas each of these studies reported finding an increase in alpha as a function of the number of enhance-alpha feedback trials, whether wholly or partially accountable for in terms of increasing adaptation, Peper and Mulholland (1970) failed to obtain such an effect. Thus, not only did they fail to demonstrate an operantly conditioned alpha increase but they failed even to demonstrate an adaptation-related alpha increase. Peper and Mulholland offered as a tentative explanation for the former finding the fact that their subjects were given insufficient feedback practice (i.e., only 20 minutes). The latter finding does not appear to admit of a simple explanation, however, especially in view of the fact that Peper and Mulholland do not report having permitted their subjects an adaptation period prior to the commencement of the study proper.

Using rigorous operant conditioning experimental methodology, Beatty (1971) investigated feedback-associated EEG control. The use of the operant paradigm suggested a number of controls that had not previously been employed in the field. For example, to demonstrate that it was in fact the contingency of response and reinforcer that was responsible for any observed alteration in the experimental group's EEGs, a yoked control group which received only non-contingent reinforcement was employed. Twenty-seven naive experimental

subjects/

subjects and 9 naive matched (with respect to EEG baselines) yoked controls were subjected to the following eyes-open experimental procedure. After a 300-second baseline period, one of three discriminative stimuli informed subjects as to their task requirement for a particular experimental trial. One light signalled an alpha trial, a second a beta trial and a third a rest period. Their success at meeting the indicated task requirement was signalled by the loudness of a tonal feedback signal. Additional (extra-trial) rewards for task success were also provided. There were 10 X 200-second reinforcement trials divided into 5 blocks in which the ordering of alpha and beta trials was randomised. Each block was separated by a rest period of at least one minute duration. The results indicated that the experimental subjects, but not the yoked controls, learned to respond significantly differently with alpha during the alpha trials and the beta trials. The learned differential alpha-responding was found furthermore to increase significantly as a function of the amount of contingent reinforcement. Similarly, the experimental subjects receiving contingent reinforcement, but not the yoked controls, learned to respond significantly differently with beta during the alpha and the beta experimental trials. Initial alpha abundance was not found to be predictive of subjects' relative efficiency in learning differential EEG control.

Whilst this study clearly demonstrates the phenomenon of operantly conditioned EEG differentiation for both alpha and beta, little else may be validly concluded. For example, since no attempt was made to relate alpha changes found in the various experimental trials to any form of alpha baseline, it is unclear whether the conditioned alpha differentiation was a function of both conditioned alpha enhancement and conditioned alpha suppression or just one of these conditioned changes. The same applies for conditioned beta differentiation. These interpretation difficulties have arisen not so much as a result of inadequacies in the experimental design which, in fact, did include a free-operant (baseline) condition, but rather as a result of a limited analysis of the available data. These problems may be seen to be a direct result of the failure on the part of Beatty (1971) to meet Katkin and Murray's (1968) first minimal criterion.

Beatty (1972) conducted a study in which an attempt was made to evaluate the effects of informational feedback, cognitive set and expectations on EEG

control/

control. These two sets of independent variables were manipulated independently and in interaction and their effects on EEG control assessed. The informational feedback variable consisted simply of EEG feedback whilst the cognitive set variables consisted of providing subjects with information drawn from the literature about the subjective and behavioural concomitants of alpha and beta. Forty-five subjects were assigned to one of five groups - a feedback-only group, an instructions-only group, a feedback and instructions group, a control group with neither treatment and a group given both treatments but inappropriately matched - and subjected to an experimental procedure essentially similar to that of Beatty (1971). The results indicated that the feedback-only, the information-only and the feedback and information treatments were equally effective in allowing subjects to produce the EEG changes demanded by the experimental design. On the other hand, if they were given neither treatment or given the treatments inappropriately matched, no EEG control emerged.

Beatty (1972) appears to have satisfactorily demonstrated that feedback alone, information alone or an interaction between these two treatments are equally effective in bringing about differential EEG control. However, as in his earlier study (Beatty, 1971), the possible efficacy of these treatments for both increasing and decreasing alpha are confounded. That is, the results do not permit one to establish whether the differential EEG control is due to learned bidirectional EEG changes or merely to a learned unidirectional EEG change.

On the basis of his findings, Beatty (1972) concluded that the abilities to both increase and decrease alpha were dependent upon pre-existing and relatively dominant response strategies. More specifically, this conclusion arose out of his finding that even when given only EEG subjective and behavioural association information, subjects almost immediately exhibited differential EEG control. His interpretation is partially contradicted by that of Peper and Mulholland (1970) who suggest that whilst alpha decreases may be dependent upon overlearned responses, possible alpha increases would probably be dependent upon responses not yet within one's behavioural repertoire (see section 2.4). In view of the fact, however, that Beatty (1972) has not even conclusively demonstrated operant alpha enhancement, but merely differential alpha control, his interpretation appears to be founded on inadequate data. Furthermore, Peper and Mulholland's

(1970) interpretation/.....

(1970) interpretation appears to be more consistent with the findings of the majority of studies in the area - namely that whilst control over alpha decreases are relatively quick and easy to demonstrate, alpha increases appear far more difficult to demonstrate.

This study has pointed to the importance of at least one set of variables that needs to be considered when evaluating the research in the area. These are the variables of cognitive set and expectancy. Beatty (1972) has conclusively demonstrated the potentially confounding influence of these factors upon the interpretation of data in the area.

Walsh (1972) performed a study to investigate two controversial issues in the area. The first concerned the question of whether the alpha control so frequently reported in the literature was simply a function of learned alpha suppression and not learned alpha enhancement. (The present review has repeatedly pointed to the lack of clarity on this issue.) The second was to determine whether many of the psychological and subjective effects attributed to alpha feedback might not actually result from alternative social, cognitive and physiological influences. This aim should be distinguished from that of Beatty (1972) who investigated the influence of these kinds of factors on alpha control. Forty subjects were given psychological tests and then assigned to one of four experimental conditions; (1) alpha instructions with alpha training; (2) alpha instructions with non-alpha (placebo) training; (3) neutral instructions with alpha training; and (4) neutral instructions with no alpha training. Each subject was given two training sessions with randomised eyes-open and eyes-closed training conditions in which tonal feedback signalled either the presence or the absence of alpha.

It was found that only one condition - alpha instructions with no alpha training - manifested significant alpha control whilst no significant alpha enhancement at all was demonstrated. Walsh (1972) took these findings to provide partial support for the hypothesis that alpha control resulting from biofeedback training is a function of learned alpha suppression rather than alpha enhancement. This conclusion appears unjustified in view of the experimental findings. It has been found generally that the influence of alpha suppression, being an easier and quicker response to learn to produce, usually predominates over possible alpha enhancement in differential alpha

control/

control studies - particularly during the earlier stages. In view of the fact therefore that Walsh barely even demonstrated alpha control, it is hardly to be expected that the alpha enhancement component of this alpha control would reach significance. Walsh appears thus to have been unsuccessful in providing additional information on this important and controversial issue.

Walsh also found that a combination of alpha instructions and alpha training produced significantly more "alpha-like" subjective reports than did any of the other three experimental conditions. This evidence supported the conclusion that so-called alpha experiences result from socially induced expectations acting in combination with the physiological effects of alpha activity. Finally, it was also established that baseline alpha levels were positively correlated with hypnotic susceptibility, "intuition" and positive attitudes towards various means of expanding internal subjective awareness. This was taken to support the hypothesis that subjects who are most successful at alpha feedback training normally show high levels of alpha activity and possess certain associated traits indicative of a passive orientation away from external reality and toward inner subjective states.

Hord and Barber (1971) tested 22 subjects in an alpha control study. Tonal feedback in the eyes-open condition was employed. Each of two experimental sessions consisted of a brief period of familiarisation or adaptation followed by 8 X 8-minute experimental conditions; (1) Baseline; (2) Alpha on, no feedback; (3) Alpha on, with feedback; (4) Alpha off, no feedback; (5) Alpha off, with feedback; (6) Alpha on, no feedback; (7) Alpha on, with feedback, and (8) Recovery, which was equivalent to the first condition. During the first experimental session the tonal feedback was made contingent upon the presence of alpha and during the second session upon an absence of alpha. For the purpose of data analysis, conditions (1) and (8) were combined to give baseline data, (7) and (3) for enhance-alpha with feedback, and (2) and (6) for enhance-alpha without feedback. It was found that the alpha levels during the enhance-alpha conditions were significantly higher than during the basal conditions and that the alpha levels during the suppress-alpha conditions were significantly lower than during the basal conditions.

Both of these findings, alpha enhancement and alpha suppression, satisfy Katkin and Murray's (1968) first minimal criterion. Katkin and Murray's second criterion is partially met. That is, a within-subjects control condition was employed wherein the operant and the free-operant (or basal)

conditions/

conditions were interspaced. However, Hord and Barber (1968) failed to systematically randomise the ordering of the different experimental conditions within each experimental session. This failing had the affect of possibly exposing the data to weak unwanted positional influences. Since the conditions were somewhat randomised, however, this criticism is not serious and Hord and Barber appear therefore to have conclusively demonstrated the phenomena of operant alpha enhancement and operant alpha suppression.

Hord and Barber also concluded on the basis of their data that tone-on and tone-off were equally effective modes of feedback. It should be pointed out, however, that the experimental design resulted in the alpha-off mode feedback sessions always following the alpha-on mode feedback sessions. No attempt was made to balance the ordering of these two modes of feedback and consequently the data, from which were derived conclusions relating to the relative efficacy of the two feedback modes, are contaminated by positional effects. A third major conclusion, namely that alpha control was equally good with and without feedback is also rendered slightly questionable by their failure to systematically randomise the ordering of experimental conditions within experimental sessions. Hord and Barber's (1971) final major finding was a significant positive correlation between alpha control and basal alpha levels. This finding is supportive of that of Walsh (1972). They interpreted this finding to be due to the fact that the relatively high alpha subjects received a more optimal level of feedback.

Sachs, Fenwick, Marks, Fenton and Hebden (1971) investigated the effects of auto-control of the alpha rhythm on possible associated feeling states. Sixteen subjects were tested in the eyes-open condition and light feedback, similar to that employed by Brown (1970), signalled the presence and the amplitude of alpha activity. The experimental design consisted of 9 blocks of 3 kinds of 3-minute experimental conditions; (1) suppress-alpha with feedback; (2) basal condition without feedback; and (3) enhance-alpha with feedback. The results indicated that only 6 of the 16 subjects achieved control over the amplitude component of the alpha rhythm; that is, produced significantly higher amplitude alpha during the enhance-alpha than during the suppress-alpha conditions. Also, two semantic differentials and an unstructured interview failed to uncover any significant high-amplitude alpha/feeling state associations.

This study is open to criticism, however, on a number of counts. Firstly,

it fails/

it fails to report whether the alpha amplitude control achieved by the six subjects was a function of (1) learned alpha amplitude increases; (2) learned alpha amplitude decreases; or (3) a combination of these two effects. Thus, although the experimental design would have permitted it, alpha amplitude increases and decreases relative to basal alpha amplitude were not reported. A second major failing was that of not systematically randomising the ordering of the three experimental conditions within each of the 9 blocks and consequently a potentially powerful and unwanted confounding influence in the form of a positional effect was introduced. Would not, for example, the suppress-alpha amplitude conditions have been contaminated by being repeatedly preceded by the enhance-alpha amplitude conditions? Finally, this study's failure to demonstrate EEG/mental state associations may conceivably be due to the very weak conditioning effect achieved and consequently the negative findings of this study should not necessarily be considered contradictory to the positive findings obtained by Kamiya (1962, 1968, 1969), Green, Green and Walters (1970, 1971), Nowlis and Kamiya (1968), Brown (1970, 1971) and Peper and Mulholland (1970).

Travis, Kondo and Knott (1972a) performed a study to evaluate the effects of contiguous versus non-contiguous reinforcement on alpha enhancement. Light feedback, given in an eyes-open condition, was employed. Twenty-four subjects were divided into three experimental groups; (1) an experimental group given contiguous (with alpha) reinforcement; (2) a yoked control group; and (3) a non-reinforcement control group. All subjects were given 6 X 10-minute alpha enhancement trials on each of two days. The results indicated that on the first day the experimental group produced significantly more alpha than either of the two control groups. On the second day, after the yoked control group of the first day had been given contiguous reinforcement, it was found that both contiguous reinforcement groups produced significantly more alpha than the non-reinforcement group. It was also observed, over both experimental days, that those groups that received contiguous reinforcement, but not those receiving non-contiguous or no-reinforcement, increased their alpha levels significantly over trials within an experimental session. The experimenters concluded that the alpha enhancement was related to a crucial contiguity between alpha production and the feedback stimulus.

This study appears to satisfy all three of Katkin and Murray's (1968) minimal

criteria/

criteria for the acceptability of evidence for operant conditioning. Although the experimental group's alpha increase was not related to its own free-operant basal alpha level, it was shown to exceed the alpha levels of both of its free-operant control groups. The second criterion, that of employing an adequate control group, is clearly met. Finally, with the possible exception of an explanation of the data in terms of mediation (see section 2.4.3), no obvious alternative explanation appears likely. Travis, Kondo and Knott (1972a) thus appear to have conclusively demonstrated the phenomenon of operant alpha enhancement.

The possible interaction effects of the sex of the subject with the sex of the experimenter in an alpha feedback training situation was investigated by Travis, Kondo and Knott (1972b). Twenty-eight subjects, consisting of 14 males and 14 females, were run by two experimenters, one male and one female, each of whom ran 7 male and 7 female subjects. Each subject was given 5 X 10-minute training trials in the eyes-open condition. Light reinforcement was made contingent upon the production of criterion alpha. The results indicated no significant sex of experimenter/sex of subject interaction effect to exist in this kind of feedback situation.

Silverman and Sherwood (1971) attempted to operantly condition the amplitude component of the EEG. Subjects were given 4 X 1-hour training sessions in which both light and tonal reinforcement, given in an eyes-open condition, were made contingent upon the production of criterion amplitude EEGs. Each experimental session consisted of a short eyes-closed rest period followed by 4 blocks of "On" trials and "Off" trials in which subjects were respectively required to produce and inhibit the criterion amplitude-associated feedback signals and a 5th "On" and "Off" block without feedback. The results indicated that significant differential EEG amplitude control could only be demonstrated by combining the data from experimental blocks 4 and 5. Furthermore, no significant differences in differential EEG amplitude control were found between the 4th feedback session and the 5th non-feedback session. It was also observed that in all cases high amplitudes were associated with alpha and low amplitudes with higher frequencies. The experimenters concluded that learned differential EEG amplitude control can transfer to a non-feedback condition.

Although operant EEG amplitude differentiation appears to have been demon-

strated, by/

strated, by failing to relate the possible operantly conditioned EEG amplitude increases and decreases to an adequate free-operant EEG amplitude level as is required by Katkin and Murray's (1968) first criterion, one is unable to establish whether the control demonstrated was a function of both learned increases and decreases in EEG amplitude or simply a function of a learned unidirectional amplitude change. The within-subjects bidirectional control procedure employed by this study, although adequate for the simple demonstration of an operant differential control effect, is incapable of satisfying Katkin and Murray's second minimal criterion for the operant conditioning of a specific change such as an EEG amplitude increase or decrease.

Schwartz, Shaw and Shapiro (1971) conducted an experiment to investigate the possible specificity of operantly conditioned alpha and heart-rate changes. Twelve subjects were tested on their ability to control their alpha abundance and their heart-rates, then given 4 daily 1-hour feedback-training sessions and finally tested again on their ability to control alpha and heart-rate. Both pre- and post-experimental sessions consisted of a three-minute baseline period, 5-minutes to increase alpha with feedback, 5-minutes to decrease alpha with feedback, a second three-minute baseline period, 5-minutes to decrease heart-rate with feedback and 5-minutes to increase heart-rate with feedback. The results indicated that prior to the alpha and heart-rate feedback training, subjects were unable to differentially control their alpha but were able to produce a 5 beats-per-minute difference in heart-rate unaccompanied by alpha changes. After the four feedback training sessions, however, subjects evidenced significant alpha control unaccompanied by heart-rate changes whilst their ability to control their heart-rates remained unchanged. On the basis of this data, as well as upon an analysis of subjective report data, the experimenters concluded that the mechanisms of alpha control and heart-rate control are distinct. These findings are consistent with the earlier observations of Kamiya (1962) and support the notion that operantly conditioned EEG changes, like operantly conditioned autonomic response changes (Miller, DiCara, Solomon, Weiss and Dworkin, 1970), are specific.

Honorton, Davidson and Bindler (1972) performed a study to investigate feedback-induced EEG changes and possible changes in associated subjective reports. Twenty-three subjects were given auditory feedback in an eyes-

closed condition./

closed condition. Each 1-hour experimental session consisted of 10 alternating blocks of 3 kinds of experimental condition - enhance-alpha with feedback, rest without feedback and suppress-alpha with feedback. The ordering of the 3 experimental conditions within the blocks was counter-balanced. Subjective activity was assessed by means of an "on line" state report scale in which the subjects called numbers between 0 and 4 to indicate their degree of relaxation and attention to external stimuli and also by a more conventional post-experimental interview. The results indicated that the group as a whole differed significantly over the 3 experimental conditions and that each individual subject achieved a significant alpha generation/suppression difference. The results furthermore appear to indicate that the suppression/rest (16% - 36%) difference but not the generation/rest (40% - 36%) difference was significantly different for the group as a whole. The alpha generation conditions were found to be associated with significantly higher "on line" state reports than were the alpha suppression reports. The degree of shift in state report over the experimental conditions was found furthermore to be significantly related to a subject's degree of alpha shift over the conditions. High state reports were also significantly associated with less REM activity (Rapid Eye Movement activity recorded from the supra-orbital-canthus muscles) and less EMG activity (Electromyograph activity recorded from the frontalis muscles) than low state reports. Finally, these state reports were found to relate significantly to the post-experimental interview data. The experimenters concluded on the basis of this converging data that high alpha is associated with a narrowing of perceptual awareness, relaxation and altered states of consciousness in some subjects.

The EEG/subjective state associations reported by Honorton, Davidson and Bindler (1972) essentially support the findings of Kamiya (1962, 1968, 1969), Green, Green and Walters (1970, 1971), Nowlis and Kamiya (1970), Brown (1970, 1971) and Peper and Mulholland (1970). This study, however, although conclusively demonstrating the phenomena of operant alpha decreases and operant differential alpha control, fails to conclusively demonstrate operantly conditioned alpha enhancement. Like Kamiya's (1969) study, which this experiment closely mirrors in both experimental design and actual EEG data, this arises out of a failure to meet Katkin and Murray's (1968) first criterion. Since this issue has been discussed at length in the review of this earlier study (Kamiya, 1969), it will not be repeated here.

2.3 EEG Alpha and Hypnotic Susceptibility

The traditional trance hypnosis paradigm¹ has stimulated much research effort toward the denotation of the neurophysiological correlates of the hypnotic trance state. Studies attempting to relate hypnosis to changes in metabolic rate, skin conductance, heart-rate, blood pressure, respiratory rate, digital blood volume, oral temperature and other physiological parameters have yielded varied and conflicting results (see reviews in Gorton, 1949; Weitzenhoffer, 1953; Sarbin, 1956; Crasilneck and Hall, 1959; Levitt and Brady, 1963; Barber, 1965; Jana, 1967; Edmonston, 1968, and Timney and Barber, 1969) and it is generally concluded by both trance and alternative paradigm theorists alike that no physiological evidence has yet been shown to convincingly differentiate the hypnotic from the waking state.

More specifically, attempts to relate hypnosis to EEG parameters, a strategy once thought to be highly promising, has similarly failed to demonstrate a convincing relationship. The weight of evidence favours the view that a subject continues to elicit his characteristic waking EEG pattern in the hypnotic state (Chertok and Kramarz, 1959; Diamont, et al, 1960; Snyes 1947; Loomis, Harvey and Hobart, 1936; Weitzenhoffer, 1953; Barber 1970). Where studies have reported EEG alterations to accompany an hypnotic manipulation (Barker and Burgwin, 1948; Schwartz et al, 1955, and Chertok and Kramarz, 1959), they have invariably been shown to be related to the suggestions given to the subject rather than to hypnosis per se.

In 1968, however, London, Hart and Leibovitz (1968) reported significant findings from a study employing a different type of research strategy. Instead of attempting to differentiate - within-subjects - between the waking and the hypnotic state, they attempted to relate - between-subjects - hypnotic susceptibility to EEG factors. This research strategy was first employed by London and Mc Devitt (1967) in a study that found that low and high hypnotic susceptibility subjects differed significantly on a number of base-rate measures of autonomic functions.

London, Hart and Leibovitz (1968) investigated the relationship between hypnotic susceptibility and the duration of the occipital alpha rhythm. Of 154 female subjects who volunteered for the study, 125 eventually completed all the tests. The following battery of tests was given to each subject:

(1) group/.....

¹ For critical evaluations of the traditional trance hypnosis paradigm and the alternative non-trance "hypnosis" paradigm, see Spanos, 1970; Spanos and Chaves, 1970; Barber, 1972.

(1) group and individual tests of visual and other imagery; (2) the Harvard Group Scale of Hypnotic Susceptibility (HGSS) administered by tape recorder (Shor and Orne, 1962); and (3) an individually administered EEG. The EEG test-session consisted of 10 X 2-minute eyes-closed trials during which subjects were requested to relax followed by a single 2-minute eyes-closed visual imagery trial. The occipital alpha channel was used to obtain alpha durations. For analysis purposes, HGSS scores were grouped into 4 categories of increasing hypnotic susceptibility. An Analysis of Variance revealed that EEG alpha durations differed significantly across these groups - under both operant conditions where no special instructions were given and in the conditions where subjects were instructed to engage in active visual imagery. The major finding was that of a significant and positive relationship between alpha abundance and hypnotic susceptibility. A secondary finding was that this relationship was maintained under both the operant and the visual imagery conditions. London, Hart and Leibovitz (1968) contended not only that the data supported the idea of hypnotic susceptibility being a stable personality trait with measurable physiological substrates but also suggested that the data provided clues as to the reason for the failure of previous studies to find alpha differences between the hypnotic and the waking state. They stated that, "because most experiments use highly susceptible subjects, and because the highly susceptible subject may routinely produce high alpha under waking conditions, then no change may be observed under hypnosis merely because a ceiling effect is inherent in the subject selection process."

Nowlis and Rhead (1968) independently investigated the same problem - that of the relationship between alpha and hypnotic susceptibility - in another laboratory. Twenty-one subjects, both males and females, were tested on hypnotic susceptibility by means of the orally and individually administered Stanford Hypnotic Susceptibility Scales, Forms A and C (Weitzenhoffer and Hilgard, 1959, 1962). An EEG testing session followed in which a 2-minute EEG sample was recorded and the percentage time alpha computed. The electrode placements were either occipital-frontal or occipital-central and the EEG amplification gains were variable. The statistical analysis of the data revealed that hypnotic susceptibility and baseline percentage time alpha were significantly correlated for both males and females. These findings are congruent with those of London, Hart and Leibovitz (1968). The experimenters advised caution, however, in interpreting these results for three reasons. The first was that they considered a 2-minute EEG experimental session too

short/

short to be entirely adequate. The second involved the interpretation difficulties that arose out of the use of variable EEG gain settings. And finally, they considered the sample size too small for them to have complete confidence concerning the generalisability of their findings. Notwithstanding the above, Nowlis and Rhead (1968) tentatively offered two possible explanations for their findings. They suggested firstly that people who tend to relax and "let go" spontaneously in the laboratory could well be more hypnotisable, and since alpha had been found to be associated with this kind of mental activity (Kamiya, 1968), the obtained relationship between alpha and hypnotic susceptibility could simply be the discovery of a long-term psychophysiological tendency in operation. Their second explanation, this time in terms of short-term social psychological situational factors, suggested that those subjects who respond well to hypnotic susceptibility might subsequently come to regard the whole experimental situation more positively and consequently relax more and produce more alpha than the low susceptibility subjects in the experimental situation. A final explanation of the alpha/hypnotic susceptibility relationship phenomenon, they suggested, may involve an interaction of the above two explanations.

Galbraith, London, Leibovitz, Cooper and Hart (1970) performed a study aimed at extending the findings of London, Hart and Leibovitz (1968) and Nowlis and Rhead (1968) by means of sophisticated spectral EEG analysis techniques. Subsequent to being given the HGSS by experimenters "blind" to the intentions of the rest of the study, 59 volunteer subjects (25 males and 35 females) were tested under conditions of rest and under conditions of auditory and visual sensory stimulation whilst selectively attending during a 1-hour EEG test-session. The EEG data were collected and computer analysed by experimenters "blind" to the subjects' HGSS scores. Spectral analysis, that is, the EEG intensity occurring at different frequencies in a single EEG lead, and cross-spectral analysis, that is, the quantity of shared intensity between pairs of EEG leads (see Blackman and Tukey, 1959; Walter, 1963), were computed. Spectral analyses were carried out to determine the combination of EEG leads and the EEG frequency range most predictive of HGSS scores. The results indicated that the occipital autospectrum and the occipital-vertex cross spectrum were most predictive of hypnotic susceptibility, particularly during the condition of selective visual attention. Low frequency EEG ranges, particularly between 5 - 7 Hz, were found to be the most predictive frequency range. The experimenters concluded that their

findings/

findings supported and extended the earlier findings of London, Hart and Leibovitz (1968) and Nowlis and Rhead (1968). They concluded, in addition, that had these earlier studies not band-pass filtered their EEG signals in the alpha frequency range, thus excluded the most predictive slow EEG frequencies from their analysis, even more significant hypnotic susceptibility/EEG frequency range relationships might have been demonstrated.

Engstrom, London and Hart (1970a,b) were the first to report a study which employed the sophisticated technology of alpha feedback to further the investigation of the relationship between alpha and hypnotic susceptibility. They hypothesized that feedback to increase alpha duration would result in raised hypnotic susceptibility. From an initial 180 volunteers, only 30 subjects (10 males and 20 females) were selected for the alpha training program and the experiment proper. The selection resulted in the elimination from the study of all subjects except those who both scored relatively low on hypnotic susceptibility (i.e., averaged a score of 7 or less on the HGSS and SHSSs) and relatively low on percentage time alpha (i.e., 50% or less averaged over a 2-minute eyes-open and a 2-minute eyes-closed test condition). Of the subjects selected for the training sessions, 20 were randomly assigned to an experimental group which received alpha-contingent feedback and 10 were assigned to a yoked control group. All subjects were informed that they were involved in a study of brain wave control as a means of enhancing hypnotic susceptibility. The training program consisted of 6 sessions, each involving a 4-minute basal EEG trial without feedback followed by 6 X 5-minute enhance-alpha trials with feedback. At the end of each session subjects evaluated their feelings during alpha and/or hypnosis by rating each of 48 adjectives describing different mental states. At the end of the last training session, a final basal EEG measurement was recorded and the SHSS, Form B, was administered by an experimenter who had not previously tested the subject. The results indicated that hypnotic susceptibility and the operant (basal)alpha rhythm were positively related both before and after feedback training. Changes in both variables from pre- to post-training also yielded significance. Furthermore, it was found that the experimental and the control groups increased significantly in terms of both alpha duration and hypnotic susceptibility. The experimental group's increase over both these variables were found, however, to be significantly greater than that of the control group. Finally, the scores on the 48 adjectives describing hypnosis and alpha yielded a significant correlation, indicating that the two experiences were typically experienced as very similar subjective states.

This study not only lends support to the findings of London, Hart and Leibovitz (1968), Nowlis and Rhead (1968) and Galbraith et al (1970) but it also provides strong evidence for the hypothesis that feedback training to increase alpha duration may result in increased hypnotisability. Although subjects were unfortunately informed as to the nature of the experimenters' expectations, thus possibly introducing unwanted "demand characteristics" influences (Orne, 1966, 1967), the employment of a yoked control group prevented these influences from being confounded with the experimentally relevant variables.

Katkin and Murray's (1968) three minimal criteria for the acceptability of evidence for operant conditioning were also met by this study. Firstly, alpha in the feedback trials increased to a level significantly in excess of the alpha in the free-operant (basal) trials. Secondly, this increase was significantly greater for the experimental than for the control group. Finally, no obvious alternative explanation for the data appears evident. Engstrom, London and Hart (1970) thus appear to have provided convincing evidence in support of operantly conditioned alpha enhancement.

Engstrom, London and Hart (1970a,b), attempting to demonstrate that their findings were consistent only with the trance hypnosis paradigm, contended that the "experimental demonstration of a functional relationship between EEG alpha and hypnotic susceptibility challenges widely held theories of hypnosis, especially role-playing theories, and supports the idea that hypnosis is a psychophysiological state." This statement incorrectly implies that the mere demonstration of a relationship between the personality trait - hypnotic susceptibility (or ability to respond to test suggestions, as alternative paradigm theorists term it) - and a psychophysiological parameter, necessarily supports the view that hypnosis is a physiologically indexed altered state of consciousness. Engstrom, London and Hart's (1970a,b) deductive statement contains an unwarranted logical leap. Possibly the most telling argument against their contention, however, is the fact that the above findings are also totally consistent with the non-trance "hypnosis" paradigm. Since Barber (1971), for example, equates "hypnotisability" with "readiness to respond to suggestions", he interprets these findings to suggest a relationship between responsiveness to suggestions and the "many variables that constitute EEG alpha training." Since he (Barber, 1969) has already empirically demonstrated the social psychological correlates of responsiveness to test-

suggestions/

suggestions, it is quite consistent with his approach that physiological correlates might also be identified.

An alternative explanation for the findings of Engstrom, London and Hart (1970) has been offered by Doxey (1971) who suggested that the increase in hypnotic susceptibility reported to accompany operantly conditioned alpha enhancement is due not to the direct effect of the EEG changes but rather to changes in secondary factors, which closely but not perfectly, correspond to alpha and hypnotic susceptibility as measured on "relaxation based" scales such as the HGSS (Shor and Orne, 1962) and the SHSS (Weitzenhoffer and Hilgard, 1959, 1962). These secondary influences are the somewhat paradoxical passive attentional factors - what Green, Green and Walters (1970) termed "passive volition". Passive attentional states have been shown by Kamiya (1962, 1968, 1969), Green, Green and Walters (1970, 1971), Nowlis and Kamiya (1968), Brown (1970, 1971), Peper and Mulholland (1970) and Honorton, Davidson and Krippner (1972) to be closely related to high EEG alpha levels and is similarly thought by many to be an important factor influencing hypnotisability (Galbraith et al, 1970 and Miller, Galanter and Pribram, 1960). It consequently follows that feedback training to enhance alpha would also very likely teach subjects control over associated passive attentional responses (or non-orienting) and that these now well-learned responses would become available within the subjects' behavioural repertoires for transference to relaxation-hypnotic situations, resulting in raised hypnotic susceptibility. Whether or not these learned attentional factors would also transfer to non-relaxation hypnotic treatments or to basal suggestibility treatments is a doubtful empirical question that the present study attempted to answer.

Doxey (1971) asserted further that any technique that resulted in a strengthening of passive attentional responses would similarly, in this indirect manner, result in raised hypnotic susceptibility. EMG (electromyograph) or muscle relaxation feedback as described by Budzyski (1970) was suggested as a possible technique that might result in comparable hypnotic susceptibility increases (on appropriate relaxation scales). The results of an EMG feedback research project by Wickramasekera (1971) have lent support to this view. Employing an experimental and a yoked control group, he found that the experimental group not only achieved a significantly greater degree of forehead muscle relaxation but also increased significantly more on hypnotic

susceptibility/

Honorton, Davidson & Bindler, 1972; Peper, 1972). The employment of this control procedure requires, additionally, that the ordering of the interspaced conditions be systematically randomised. The failure of a number of experimenters to do this has resulted in the contamination of their data (Hord & Barber, 1971; Sachs, Fenwick et al, 1971). Another within-subjects control procedure, one that attempts to obtain a "true" baseline condition against which to relate experimental (or operant) conditions, consists of permitting subjects sufficient time to completely adapt (or habituate) to the experimental situation prior to the recording of baseline data.

These are the minimal control standards that need to be satisfied in order that criterion one may be validly applied to the data.

2.4.3 Criterion Three - Are the data, within reasonable limits, free from obvious alternative explanations? The most obvious kind of alternative explanation for the apparent direct operant conditioning of the EEG is that the effect is mediated by means of the operant conditioning of some other voluntary response or responses. Skinner (1938) has suggested no less than four ways in which such apparent operant conditioning may occur (see Appendix L). Lynch and Paskewitz (1971), in their review of the mechanisms of alpha control, concluded that it "... does seem apparent, however, (that) alpha activity is mediated by a whole host of factors, and that the likelihood of ever controlling or eliminating all of these factors to observe only simple alpha conditioning is extremely small. Thus, in the more restricted sense, any discussion of the operant control of alpha activity seems to us, operationally indefensible." There are at least three such voluntary responses that are thought to have the capacity to mediate changes in alpha - alterations in cognitive mode, changes in affective arousal and changes in oculomotor efferent activity.

Cognitive mediation (which corresponds to Skinner's fourth way in which apparent operant autonomic response conditioning may occur) has been invoked as the explanation for the phenomenon by Green, Green and Walters (1971) who wrote that: "In actuality there is no such thing as training in brain wave control; there is training only in the elicitation of certain subjective states that are accompanied by oscillating voltages in the cerebral cortex, detected through the subject's skull and scalp. Brain waves, as such, are not known to have any sensory representation whatsoever

by means/

by means of which they can be detected. What are detected and manipulated in some unknown way are foci of attention, thought processes, and subjective feelings. ... it can be said that we do not attempt to train people in the production of low-frequency alpha and theta rhythms, but rather to train them in the voluntary control of certain existential states whose central-nervous-system correlates are revealed by the presence of low-frequency alpha and theta rhythms in the EEG record." These existential states are, of course, the relaxed, passive, non-critical mental states reported to be associated with alpha.

Nideffer (1973) has suggested that such factors as anxiety and affective arousal may be even more central to the development of alpha than eye-accommodation. He said that; "It may be hypothesised that, within an individual, as affective arousal (emotional involvement) increases, alpha will decrease. That is, alpha should be produced so long as stimuli are not being reacted to in an ego-involved way. If attention is possible, as meditation procedures would suggest, within ego or personal involvement, and without changes in ocular accommodation, then alpha may be present. ... In fact, it is explicitly maintained that for alpha to occur, the accommodation triad must not be stabilised and arousal level must be low."

Mulholland (Mulholland, 1968, 1969a, b, 1972; Mulholland & Davis, 1966; Mulholland & Evans, 1965, 1966; Mulholland & Peper, 1971; Mulholland & Runnals, 1962a, b, 1963, 1964a, b), Peper (Peper, 1971, 1972; Peper & Mulholland, 1970) and Dewan (Dewan, 1967; Dewan & Mulholland, 1969) have shown the importance of visual-motor activity in the "alpha-attenuation cycle". They suggested furthermore that the increases in alpha associated with alpha feedback training are likely to be mediated by the learned control of oculomotor and lens adjustment processes of which the subject may not necessarily be aware (Mulholland, 1971). Since oculomotor efferent commands appear to bear a one-to-one relationship to alpha desynchronisation (Peper, 1970), Mulholland (1972) has hypothesised that refraining from visual-motor activity is a necessary, but not sufficient, condition for the occurrence of alpha. Peper and Mulholland (1970) have, in fact, hypothesised that whilst alpha suppression in an alpha feedback situation is mediated via the elicitation of the overlearned orienting response, alpha enhancement is mediated via the gradually acquired response of non-orienting. That is, a subject learns to suppress his alpha by simply "paying attention", thus

eliciting an/

eliciting an orienting response with its associated oculomotor efferent activity. On the other hand, in order to enhance alpha, the subject has gradually to learn (and with some difficulty) "not to pay attention" to anything in the experimental situation. As a consequence, a passive non-critical mental state is reported to be associated with alpha (Nideffer, 1973)

Lynch and Paskewitz (1971), although less specific about implicating the relaxation of the accommodation triad in alpha enhancement, offered an hypothesis which is essentially consistent with that of Mulholland (1972). They wrote that: "It is likely that those who exhibit alpha activity during alpha feedback sessions do so, in fact, through a process of "unfocusing" attention, that is trying not to attend to any one aspect of the surroundings, thus creating a sort of perceptual deprivation. ... We suggest that alpha activity occurs in the feedback situation when an individual ceases to pay attention to any of a number of stimuli which normally block this activity."

The point should be emphasised that although oculomotor activity appears to be both a necessary and a sufficient condition for alpha attenuation, inhibition of oculomotor efferent activity appears only to be a necessary but not a sufficient condition for alpha presence. Mulholland (1968) wrote that: "I would suggest that the occipital desynchronisation process be considered to be not merely the absence or negative of the synchronisation process. Whatever the synchronisation process is, it is more probable if sensory-oculomotor processes occurring in the occipital cortex are reduced, but the reduction of excitation in the occipital cortex does not by itself account for synchrony. Some new principle is required, and we await conclusive neurophysiological studies on this point." The oculomotor efferent theory of alpha, although possibly the most valid in the area at present, is not yet capable of explaining all the phenomena within its domain. It may turn out that some new theory, perhaps one within a different paradigm (eg. the electromechanical-gel theory of Kennedy, 1959), will provide valid answers to more of the questions in the domain and consequently gradually supercede the oculomotor efferent theory.

It is tentatively suggested by the writer that the abolition of oculomotor efferent activity and its associated relaxation of the accommodation triad may be a necessary, although not sufficient, condition for the presence of alpha activity. It is furthermore suggested that decreases in this oculo-

motor efferent/

motor efferent activity may be either directly manipulated or may be mediated via any other response which is closely associated with efferent oculomotor quiescence. A study by Dewan (1967) represents probably the best example of "alpha control" mediated via the direct manipulation of visual-motor activity. There are also a number of studies (Kamiya, 1968, 1969; Brown, 1970; 1971; Honorton, Davidson & Bindler, 1972) where alpha enhancement appears to be accompanied by a passive, non-critical, non-attentional mental state in which the subjects are not aware of any oculomotor changes. Green, Green and Walters (1970) have suggested, in fact, that the alpha increases in these instances might be mediated via the subjects' learning to elicit these "existential mental states". It is suggested here, however, that these existential states do not directly mediate alpha, but rather mediate changes in oculomotor efferent activity, which in turn mediates changes in alpha. There is a considerable body of evidence to suggest that whilst active, critical, attentional states are associated with oculomotor efferent activity and activation of the accommodation triad, passive, non-critical, non-attentional states are accompanied by a relaxation of the accommodation triad. Piaget (1954) observed that " ... very early in life focussing attention is associated not only with the use of the intrinsic muscles of the eyes, but also becomes associated with muscle movements of the neck, head and body, whereby visual interest is directed toward objects. Likewise, thinking develops in conjunction with the perception and manipulation of objects and, because of this, object-oriented thought becomes intimately associated with the striate muscle effort of voluntary activity, particularly eye muscle activity." Zickmund (1969) also reported that attention, even to auditory stimuli presented in darkness, is accompanied by eye movements. Mulholland and Peper (1970) explained the phenomenon of alpha blocking by attentional states in terms of mediation by the visual orienting component of the aroused orienting response.

Affective arousal has been suggested by Nideffer (1973) to be an important variable with the capacity to mediate changes in alpha in a feedback situation. But once again, it is tentatively suggested here that these factors exert their influence on alpha via the final common pathway - the visual-motor system. It is proposed that the stimulus concomitants of affective arousal have high orienting value and consequently elicit oculomotor efferent activity (being part of the general orienting response) which mediates changes in alpha. Evidence in support of this view is

provided by Nideffer (1973) who stated that "anxiety and affective arousal also cause changes in eye accommodation."

In summary, it is tentatively hypothesised that such factors as cognitive mode and affective arousal do not directly mediate alpha changes, but rather mediate changes in oculomotor efferent activity - the final common mediational pathway - which, in turn, mediates changes in alpha.

On the basis of the evidence presented here, it would appear that there has been no conclusive demonstration of the phenomenon of pure, unmediated operant EEG conditioning. Furthermore, in view of it having been concluded that oculomotor efferent quiescence is a necessary condition for alpha, it seems as if an instance of unmediated operant alpha conditioning may be incapable of demonstration. It appears therefore that alpha feedback fails to meet the minimal requirements for it to be considered an instance of simple operant conditioning.

Another obvious alternative explanation for the phenomenon of alpha enhancement in an experimental situation suggests that alpha increases, not as a function of reinforcement, but rather as a function of the subjects' increasing adaptation to the experimental situation. That is, as the subject who is initially anxious and attentive in the novel experimental situation learns to relax and ignore the stimulus concomitants of the situation, his alpha would be expected to rise. Lynch and Paskewitz (1971) similarly warned that such factors as apprehensions about the forthcoming experiment and the novelty of the situation might depress alpha levels during the earlier stages of experiments. It thus appears that as these factors diminish as a function of adaptation, their high orienting-value stimulus concomitants similarly diminish and mediate an increase in alpha activity. It should be pointed out, however, that should the minimal control standards specified by criterion two be met, then the relative influence of these potentially confounding factors may be determined. Employment of adequate control conditions ensures that the operant alpha level may be related to either (1) a "true" or uncontaminated basal alpha level, or (2) to a basal level that is subjected to the same extra-feedback variables as the operant level.

Evidence in support of Lynch and Paskewitz's (1971) contention that alpha enhancement in a feedback situation may arise out of a dissipation of the influence of alpha-inhibitory factors has been provided by Paskewitz and

Orne (1971). Attempts to enhance alpha density under conditions of complete darkness by means of feedback were unsuccessful. However, when light was introduced, increases in alpha densities were obtained. Furthermore, significantly higher alpha densities were obtained during feedback than during intervening rest periods. Paskewitz and Orne (1971) concluded that "... the results support the view that increases in alpha densities can take place only if inhibitory mechanisms are initially present to depress densities. Increases in alpha activity may reflect an increasing ability of the subject to ignore otherwise distracting influences, and this process may account for some of the reported subjective concomitants of alpha feedback training."

2.5 Summary

Although evidence had accumulated to tentatively suggest that the EEG alpha blocking response was amenable to the techniques of classical conditioning (see section 2), it required the pioneering research of Joe Kamiya (1962, 1968, 1969) to demonstrate that EEG activity could also be modified by the more powerful and flexible technology of biofeedback or operant conditioning. Since this time, the phenomenon of enhancing and/or suppressing EEG alpha abundance by the provision to subjects of alpha-contingent feedback or reinforcement has been widely reported (Hart, 1967; Green, Green & Walters, 1969, 1970; Nowlis & Kamiya, 1970; Brown, 1970, 1971; Peper & Mulholland, 1970; Beatty, 1971, 1972; Walsh, 1972; Hord & Barber, 1971; Sachs, Fenwick, et al, 1971; Travis, Kondo & Knott, 1972a; Silverman & Sherwood, 1971; Schwartz, Shaw & Shapiro, 1971; Honorton, Davidson & Bindler, 1972; Engstrom, London & Hart, 1970a, b). For the purpose of evaluating the findings in the area, operant terminology was adopted (Shapiro & Schwartz, 1972) and within this framework it was shown that the majority of researchers attempted to demonstrate one or more of the following three kinds of operant conditioning phenomenon: (1) an operantly conditioned alpha increase; (2) an operantly conditioned alpha decrease; (3) operantly conditioned differential alpha control.

Whilst the last two phenomena were found to have been frequently and widely demonstrated (Kamiya, 1969; Nowlis & Kamiya, 1970; Peper & Mulholland, 1970; Hord & Barber, 1971; Honorton, Davidson & Bindler, 1972 for alpha suppression) (Kamiya, 1969; Nowlis & Kamiya, 1970; Peper & Mulholland,

1970; Beatty/

1970; Beatty, 1971; Hord & Barber, 1971; Honorton, Davidson & Bindler, 1972; Silverman & Sherwood, 1971 for alpha control), acceptable instances of the first phenomenon appeared to be more elusive. Although many researchers reported having demonstrated the phenomenon, only four studies succeeded in adequately satisfying Katkin and Murray's (1968) three minimal criteria for the acceptability of evidence for operant conditioning - those of Brown (1970), Engstrom, London and Hart (1970a, b), Hord and Barber (1971) and Travis, Kondo and Knott (1972a). A strict application of Katkin and Murray's (1968) third criterion led it to be conceded, however, that it is perhaps impossible to demonstrate direct operant alpha enhancement. An alternative explanation in terms of which it is seen to be an operantly-mediated effect, was tentatively proposed. Changes in oculomotor efferent activity - which may themselves be either directly or indirectly manipulated - were suggested as the most likely mediating mechanism (see Mulholland, 1968). It was concluded therefore that feedback-associated EEG changes appeared to be operantly-mediated phenomena.

With the exception of a number of attempts to measure the subjective correlates of various feedback-associated EEG states (Kamiya, 1968, 1969; Green, Green & Walters, 1970, 1971; Nowlis & Kamiya, 1970; Brown, 1970, 1971; Peper & Mulholland, 1970; Honorton, Davidson & Bindler, 1972; Sachs, Fenwick, et al, 1971), very little research has been directed toward an examination of the psychological and physiological concomitants of alpha feedback training. Schwartz, Shaw and Shapiro (1971) reported finding that the mechanisms for alpha control and heart-rate control are independent; a finding consistent with Kamiya's (1962) earlier observation of an apparent independence between conditioned alpha changes and changes in cardiac activity, respiratory activity, eye-movements and muscle tension. Engstrom, London and Hart (1970a, b) performed a study to examine the relationship between alpha feedback training and hypnotisability and reported finding that feedback training to enhance alpha duration was significantly associated with an increase in hypnotisability. Unfortunately, although their findings appeared to be acceptable, they were found to be open to a number of contradictory interpretations.

3.0 TRANSCENDENTAL MEDITATION LITERATURE SURVEY

Transcendental Meditation (TM) is a meditation technique taught by Maharishi Mahesh Yogi (1966, 1969) and is defined as, "turning the attention inwards towards the subtler levels of a thought until the mind transcends the experience of the subtlest state of the thought and arrives at the source of the thought. This expands the conscious mind and at the same time brings it into contact with the creative intelligence that gives rise to every thought (Mahesh Yogi, 1966, p.470)." Growing interest in meditation in the West has resulted in hundreds of thousands of people being initiated into the practice. In the United States alone, the number of practitioners has grown from a mere few hundred in 1965 to over 350,000 by 1973 (Newsweek, 1974). In South Africa, the number of persons initiated had risen to 4,500 by February 1974 (David Fiske, 1974).

Accompanying these trends has been an increasing interest in the phenomenon on the part of researchers. From the time of the first major scientific publication on the physiological correlates of Transcendental Meditation by Wallace, Benson and Wilson in 1971, the number of researchers engaged in psychophysiological studies had more than trebled by 1973 (Kanellakos & Ferguson, 1973). Transcendental Meditation research is currently in progress throughout the United States and Canada as well as in West Germany, Sweden, Holland, Britain, South Africa and Australia (Kanellakos & Ferguson, 1973).

Many of the studies to be reviewed here are preliminary in nature and are lacking in conventional scientific rigour. "Frequently, adequate controls were omitted, the number of subjects used was small, the criteria used for subject selection were not stated (eg., in experiments using meditation practitioners, the length of time the subjects had been practising Transcendental Meditation was not stated), and often the data were not analysed statistically" (Kanellakos & Lukas, 1973). Consequently, conclusions concerning the research data to be presented here should not be considered to be statistically significant unless this is specifically mentioned.

One method of dividing the research studies to be reviewed here is into

those that/

those that attempt to delineate the short-term psychophysiological correlates of the actual practice of Transcendental Meditation and those that attempt to determine possible long-term changes that accrue from the practice of the technique over a period of time. Perhaps a more efficient method of dividing these studies is in terms of the disciplinary level of the research. This is the approach adopted here. Consequently, those studies concerned with the more molar disciplinary measures - the physiological, electrophysiological and biochemical studies - are reviewed in section 3.1 whereas the more molar-orientated studies - the behavioural and psychological studies - are reviewed in section 3.2.

Although this review is concerned primarily with Transcendental Meditation research, important findings relating to other meditative techniques are also presented.

3.1 Physiological Correlates of Meditation

3.1.1 Electroencephalography: Das and Gastaut (1955) examined the EEG correlates of meditation in 7 yogis. They reported finding a progressive EEG change to accompany the practice. During the earlier stages of meditation, alpha activity was found to be replaced by fast wave activity of 40-45 Hz whereas during the latter stages these waves subsided and were replaced by slow alpha and even theta activity. These reported findings were derived, however, from an inadequately controlled study and from purely qualitative data that lacked statistical confirmation.

Similar EEG findings were reported by Anand, Chhina and Singh (1961b). They subjected a Hatha Yogi, one Shri Ramanand Yogi, to an intensive series of physiological and electrophysiological tests whilst he meditated in a completely air-tight metallic and glass box. EEG electrodes, ECG electrodes, respiration gas tubes, a chest strain-gauge for respiration-rate and other devices were connected to the enclosed subject. The EEG results indicated a change from waking alpha to predominant low voltage fast activity (with a few EEG biparietal humps) during meditation. These results were based, however, on subjective qualitative interpretations of the EEG record. In addition, no statistical support for the conclusions was provided.

Bagchi and Wenger (1957) conducted physiological and EEG tests on 48 yogis

over 98 experimental sessions. The sessions were conducted at a number of different laboratories, private homes, and even a mountain cave in India. The experimental procedures were thus far from standardised. Their EEG findings, also subjective, qualitative and without statistical backing, contradicted those of Das and Gastaut (1955). They reported that "... it is the normal waking alpha pattern that is seen in meditation, that is, 8.5-11 beats per second 20-100 one-millionths of a volt, sometimes $\frac{1}{2}$ or 1 beat slow, sometimes with good amplitude modulation and regularisation but without high amplitude fast waves." It is important to qualify these results, however, by stressing that the EEG data were obtained from occipital and parietal placements. No frontal EEG tracings were examined.

An EEG study of the Somadhi meditations of 4 Raj yogis was conducted by Anand, Chhina and Singh (1961a). Frontal, parietal, temporal and occipital EEGs were recorded before as well as during meditation. It was found that the yogis had persistent and well-modulated alpha activity in their resting records but that this became even more marked and persistent during meditation. They noted the similarity between their findings and those of Bagchi and Wenger (1957).

In addition to the above experiment, Anand, Chhina and Singh (1961a) also examined the EEG response characteristics of the meditating Raj yogis to photic, auditory, thermal and vibratory stimuli. It was found that although the yogis showed the usual alpha blocking response to stimuli when not meditating, this blocking response failed to habituate to the repeated presentation of the stimuli. On the other hand, when they were in their Somadhi meditation, none of the stimuli produced any alpha blocking at all. They suggested, as a possible mechanism to explain these unusual findings, that the "brain activity ... during the stage of Somadhi (has) for its basis a type of consciousness that these individuals were able to block the afferents from the Reticular Activating System and thus remain in alpha activity."

An EEG study on a number of beginning meditators was also conducted by Anand, Chhina and Singh (1961a) and they observed that "those who had a well-marked alpha activity in their normal resting records showed greater aptitude and zeal for maintaining the practice of yoga."

Even though/

Even though this study (Anand, Chhina & Singh, 1961a), along with that on Zen meditation by Kasamatsu and Hirai (1966), has probably been the most influential EEG study on meditation, it is methodologically extremely primitive. The number of subjects was unacceptably small. The conclusions were based upon the subjective assessment of individual EEG paper records, and finally, no statistical support for the conclusions was provided.

EEG studies on Zen meditation have been carried out by Ondo, (1965), Akishige (1968) and by Kasamatsu, Okuma, Takenaka, Koga, Ikeda and Sugiyama (1957). In all instances, marked increases in alpha was reported to accompany the transition from the waking to the Zen meditation state.

The most rigorous EEG study of Zen was conducted by Kasamatsu and Hirai (1966). In addition to frontal, central, parietal and occipital EEGs, pulse-rate, respiration-rate and GSRs were polygraphically recorded. The subjects comprised 48 priests and disciples of the Soto and Rinzai Zen sects ranging in age from 24-72 years and in experience at Zen from 1-20 years. Eighteen research fellows with no Zen experience served as controls. The experimental design permitted the EEG to be recorded before, during and after the practice of eyes-open Zazen meditation. (Note that, unlike the Zen, the yogis meditate with their eyes shut.) On the basis of their EEG findings, derived from their subjective interpretations of the EEG records, they hypothesised that the EEG changes accompanying Zen meditation could be divided into 4 stages indicative of increasing depth of meditation: (1) a slight change which is characterised by the appearance of alpha waves in spite of open eyes; (2) an increase in the amplitude of persistent alpha waves; (3) a decrease in alpha frequency; (4) the appearance of rhythmical theta trains, which is the final EEG change during meditation but does not always occur. It was found that the number of EEG stages a subject produced was directly related to his number of years of Zen training as well as to his degree of proficiency at Zen as evaluated by a Zen master. That is, only the most experienced monks or those rated most proficient meditators produced all four of the EEG changes.

Kasamatsu and Hirai (1966) also examined the response characteristics of the EEG during Zen meditation to "click" stimulation. Using 3 meditating Zen masters and 4 eyes-closed resting controls, they measured the alpha blocking-time to regularly repeated (i.e., every 15 seconds) click stimulation. It was reported that whereas the control subjects' alpha

blocking-times/

blocking-times decreased as a function of the number of stimuli presented, those of the Zen masters showed no such decrease. They concluded that Zen meditators show almost no habituation to stimuli during their meditation.

Kasamatsu and Hirai's (1966) study, like all those thus far reviewed, may be criticised for having failed to employ any form of automatic EEG analysis techniques (i.e., EEG paper records were visually scored) and for not supporting their conclusions with statistical evidence.

The first serious systematic study into the physiological effects of Transcendental Meditation was undertaken by Keith Wallace in the United States (1970a). Twenty-seven "normal" subjects, primarily experienced meditators (with 2-3 years experience), participated in the study. The experimental design permitted each subject to act as his own control. The experimental procedure consisted of a 15-30-minute rest period before the first pre-control measures were taken. The pre-control period comprised a 5-15-minute eyes-open period and a 10-20-minute eyes-closed period. The subjects were then permitted to meditate for 20-40 minutes before the post-control measures were obtained. The post-control period consisted of a 10-minute eyes-closed and a 5-10-minute eyes-open non-meditating period. The physiological parameters recorded included oxygen consumption, carbon dioxide elimination, cardiac output, arterial blood gas analysis, arterial blood-pressure, heart-rate, skin resistance, eye-movements and the EEG. The EEGs were recorded on tape and subsequently subjected to spectral analysis by computer. All the data, with the exception of the EEG and arterial lactate concentrations, were subjected to statistical analyses to establish whether mid-meditation values differed significantly from pre-control means. The EEG results are reviewed here whilst the other physiological results are reviewed under the appropriate sections. On the basis of his interpretation of the computer spectral analyses of the EEGs of 25 subjects, Wallace (1970a) reported that, although all subjects showed alpha in the eyes-closed pre-control period, "during meditation the regularity and amplitude of the alpha waves increased in all subjects. In 4 of the subjects, the alpha waves occasionally changed to a slower alpha wave frequency and in some cases stopped for 2-5-minute periods and low-voltage theta waves predominated." He qualified this finding by stressing that the most characteristic EEG changes - increases in slow alpha wave intensity and occasional theta waves - appear predominantly over the frontal

regions/

regions and to a lesser extent over the central regions (Wallace, 1970b). It should be stressed that no consistent EEG changes in other frequency bands or over different scalp locations were reported.

Possibly the most serious criticism that can be levelled against Wallace's (1970a, b) reported EEG findings is that he failed to support his sophisticated computer EEG analysis with statistical evidence. In addition, he visually and subjectively interpreted the computer spectral "maps". It is thus unclear whether his EEG findings were valid or statistically significant.

Wallace (1970a) also examined the EEG response characteristics of meditating subjects. Sound and light stimulation was given at irregular intervals, ranging from 20-120 seconds, to test the habituation of the alpha blocking response. He reported finding that " ... in almost all subjects, alpha blocking caused by repeated sound or light stimuli showed no habituation." Wallace's findings concerning the EEG response characteristics of Transcendental Meditation subjects during meditation may thus be seen to be similar to Kasamatsu and Hirai's (1966) findings with Zen during their meditation and to Anand, Chhina and Singh's (1961a) findings with Yoga meditators when not meditating.

Wallace, Benson and Wilson (1971) performed a study to replicate and extend the findings of Wallace's (1970a, b) earlier study. A similar experimental design in which 36 subjects acted as self-controls was used and the procedure consisted of pre-control, meditation and post-control periods. The following physiological measurements were recorded: oxygen consumption, carbon dioxide elimination, respiratory quotient, respiration-rate, minute ventilation, mean blood-pressure, diastolic blood-pressure, arterial pH, arterial pO_2 , arterial pCO_2 , base excess, blood lactate concentration, heart-rate, rectal temperature, skin resistance and EEG. The EEG data were treated as previously (Wallace, 1970a, b) - spectral-analysed but not statistically analysed. Once again, only the reported EEG results are described here. They reported finding " ... a marked intensification of alpha waves in all subjects (during meditation). ... Typically there was an increase in intensity of slow alpha waves at 8 or 9 cycles per second in the frontal or central regions of the brain during meditation. In

several/.....

several subjects this change was also accompanied by prominent theta waves in the frontal area (Wallace & Benson, 1972)". These reported EEG findings are open to the same criticisms, however, as Wallace's (1970a, b) earlier findings; that is, no statistical analysis of the EEG data was performed.

Brown, Stewart and Blodgett (1971, 1972) performed a study to investigate the EEG rhythms during Transcendental Meditation and possible changes in perceptual-thresholds following the practice. The subjects comprised 22 females who were divided into an experimental group of 11 meditators and a control group of 11 non-meditators. The experimental procedure consisted of a 3-minute eyes-open "pre-state" rest period, a 15-minute eyes-closed "consciousness state" during which the experimental subjects meditated and the controls rested, and a 3-minute eyes-open "post-state" rest period. The perceptual-threshold data were obtained before the "pre-state" period and after the "post state" period. These findings are discussed in the relevant sections (see section 3.2). The EEG data were recorded across the 3 experimental periods and the EEG records were subjected to visual analysis. They reported that whereas 10 of the 11 meditators showed a definite presence of frontal-cortical alpha waves throughout most of the meditation period, only 3 of the 11 controls showed this rhythm and with less consistency and at a much lower frequency of occurrence during the 15-minute "consciousness state". The rank-order Wilcoxon-Mann-Whitney statistical test demonstrated significance at $P < .01$. These findings may be seen to be consistent with those of Wallace (1970a, b) and Wallace, Benson and Wilson (1971) but they placed even greater emphasis on the fact that the meditation-associated EEG changes are predominantly frontal in origin. In fact, to stress this they adopted Chapman, Cavanaugh and Ernest's (1971) term, "kappa-rhythm activity" to describe the 8-12 Hz frontal area electrical activity and to distinguish it from the occipitally-located alpha rhythms. They suggested that these rhythms had different foci and that it was the kappa-rhythm activity that was characteristically enhanced during Transcendental Meditation. This conclusion is supported by a finding reported in the revision of their earlier paper (Brown, Stewart & Blodgett, 1972), claiming that they found a greater ratio of frontal/occipital 8-12 Hz EEG activity in meditating subjects than in eyes-closed resting non-meditating controls.

Even though Brown, Stewart and Blodgett (1971, 1972) subjected their EEG

data to/

data to statistical analysis, their study is open nevertheless to an important criticism. They failed to employ objective EEG analysis techniques and consequently the validity of their findings is questionable.

Kanellakos (1970) cites Timmins, Kamiya and Yeager (1970) as having examined the EEG and heart-rate activity of 8 experienced (i.e., they were teachers of the technique) practitioners of Transcendental Meditation and 8 non-meditating controls. Five EEG channels and one heart-rate channel were tape recorded. The analysed data have not yet been published but they reported tentatively that the meditation teachers generally had more alpha than the controls, both during and out of meditation. In addition, whereas in the control subjects, occasional bursts of alpha tended to appear from the occipital portion of the brain alone, the teachers had alpha appear over a much wider portion of the brain and especially over the central regions. These preliminary and somewhat tentative findings are partially supportive of those of Wallace (1970a, b), Wallace, Benson and Wilson (1971) and Brown, Stewart and Blodgett (1971, 1972).

Vassiliadis (1972) conducted a longitudinal physiological study into Transcendental Meditation. Physiological data were obtained on a group of 18 subjects once a month for a period of 6 months. The number of subjects was then increased to 45 and the tests continued for another period of 9 months. The physiological parameters examined included frontal and occipital EEGs, hand and forehead temperatures, breath-rate, skin resistance and rheoencephalograph. After the second month, half of the subjects were instructed in meditation whilst the others served as controls. The experimental procedure consisted of a 10-minute eyes-open rest condition and a 10-minute eyes-closed rest condition, a 20-minute meditation or eyes-closed rest condition (for controls) and another 10-minute eyes-closed rest condition and a 10-minute eyes-open rest condition. The recorded EEG data were automatically analysed by passing the EEG signals through band-pass filters for alpha (8-12 Hz) and theta (5-7 Hz). The filter outputs were passed through root-mean-square reading meters, integrated, and recorded. This gave a continuous indication of the signal power in the alpha and theta EEG bands. Thus far, only preliminary EEG results are available. For the purpose of statistical analysis, each subject's EEG score was "normalised" so that each individual received equal statistical weight. The EEG scores of meditators were compared with their own EEG scores prior to their starting meditation as well as with the EEG scores of the controls.

Vassiliadis (1972) reported finding that both meditator and control groups showed similar EEG characteristics in the frontal EEG regions and that no significant differences developed between the two groups over 6-9 months of meditation. Although this finding is contrary to what Wallace's (1970b) data might lead one to expect, Kanellakos and Lukas (1973) suggested, as a possible explanation for these apparently contradictory findings, that whilst Wallace's (1970b) subjects were well-seasoned meditators (with an average of 32 months experience), Vassiliadis's (1972) subjects had been practising meditation for only 6-9 months. "The differences noted may be related to the length of time of practice of Transcendental Meditation or possibly, to inevitable subject selection that occurs when data are reported for subjects who are sufficiently motivated to continue the practice of Transcendental Meditation for almost 3 years" (Kanellakos & Lukas, 1973).

Although both meditators and controls showed similar EEG patterns prior to the meditation group learning meditation, significant changes were seen in both alpha and theta content as a function of the length of practice of Transcendental Meditation. It was found that the occipital alpha power exhibited a characteristic decrease from the pre-meditation rest period through the meditation period and increased again during the post-meditation eyes-closed period. It was also found that after about 3-4 months of meditation, the meditators showed somewhat higher alpha than controls in the second half of meditation and in both the eyes-open conditions. After 6-9 months of meditation (as compared to the same group prior to meditation), although there was no significant difference between the meditation periods, a significant increase in alpha during the second eyes-closed (or post-meditation) period over that in the (pre-meditation) first eyes-closed period was found. The alpha content during both eyes-open conditions was also higher after 6-9 months of meditation.

Occipital theta also showed some significant changes after 6-9 months. Whereas prior to learning meditation, the theta power showed a general decrease from the beginning to the end of a recording session, after learning meditation, there was a gradual and significant increase in occipital theta power during the meditation so that theta power was actually higher at the end than at the beginning of a recording session.

In view of the fact that this study (Vassiliadis, 1972) employed both automatic EEG analysis techniques and statistical analysis, it is

probably/

probably in terms of scientific rigour superior to most of the other studies reviewed. The converting of raw EEG data to normalised form also probably adds to the validity of the reported findings.

A longitudinal study into physiological effects (i.e., occipital EEG, heart-rate and skin resistance) of Transcendental Meditation was carried out by Doxey (1972b). An experimental group of 48 novice meditators were tested prior to learning the technique of meditation and at monthly intervals thereafter for three months. A control group consisting of 10 non-meditators were tested at the same times. The experimental procedure consisted of a 5-minute eyes-open adaptation period, a 10-minute eyes-closed pre-experimental rest period, a 20-minute experimental period (in which the meditators meditated and the controls rested with their eyes closed) and a 10-minute eyes-closed post-experimental rest period. Each subject's EEG was automatically analysed by being passed through a 8-13 Hz (alpha) band-pass filter, the output of which operated digital counters which displayed the occipital EEG in terms of percentage time alpha. The "raw" percentage time alpha scores were then "normalised" by being converted into "percentage time alpha in z-Scores". This strategy was employed to ensure that no individual subject disproportionately influenced the group's data, thus possibly invalidating the statistical analysis. The results indicated that whilst both the meditator and the control groups increased significantly in terms of occipital percentage time alpha over the 3-month period, the increase was significantly greater for the meditation group than for the control group. Doxey interpreted the increase in alpha found for the control group (over the 4 sessions) to be a function of their increasing habituation to the experimental situation (see section 2.4.3). The greater alpha increase of the meditation group was attributed to the effects of meditation "within a broad context" and not simply to the practice of meditation per se. It was also found that the meditation group, after three months of meditation experience, produced significantly more occipital alpha during the post-meditation rest period than during the pre-meditation rest period. This finding is consistent with that of Vassiliadis (1972). Finally, it was found that the initial pre-training percentage time alpha levels significantly predicted whether subjects would continue to meditate or whether they would terminate the practice before the end of the three-month period. The initially high alpha subjects tended to have a significantly lower termination-rate over the period than the initially low alpha subjects.

Probably the most serious problem associated with this study, one that

possibly/

possibly obscures and distorts "valid" EEG trends, is the hypothesized strong "habituation effect". This effect appeared to be sufficiently powerful to account for almost as much percentage time alpha variance as the independent variable - Transcendental Meditation. The study failed to permit the subjects "sufficient" time to adapt adequately to the unfamiliar experimental situation before recording actual experimental data.

A spectral analysis of the EEG changes accompanying the practice of Transcendental Meditation was carried out by Banquet (1973). The subjects consisted of an experimental group of 12 meditators with an average of 24 months' experience and a control group of 12 matched non-meditators. The experimental sessions were as follows: a 5-minute eyes-open and a 5-minute eyes-closed rest period, a 30-minute meditation period for the experimental subjects and a 30-minute eyes-closed rest period for the controls, a 3-minute period to " ... come progressively out of meditation or relaxation" and a 5-minute eyes-closed concentration (on thoughts and images) period. Frontal, central, parietal and occipital EEGs, EMGs and respiration-rate and amplitude were recorded across the experimental sessions. The EEG data were recorded on paper and also stored on tape. A push-button code system was arranged whereby subjects could communicate ongoing psychological events to the experimenter. The taped EEG data were subjected to Fourier spectral analysis by computer and "the results were derived from the comparative interpretation of the conventional EEG and the frequency spectral arrays, for both control and experimental subjects." Banquet divided the EEG changes accompanying Transcendental Meditation into three progressive phases that appeared to be associated with increasing "depth of meditation".

- (1) The alpha activity which was found in the resting records of all the meditators became predominant at the beginning of meditation and its amplitude increased and average frequency decreased. This EEG stage was repeated at the end of Transcendental Meditation with an even greater abundance of alpha.
- (2) The first stage gave way to a second phase in which a dominant theta pattern, unlike that of drowsiness, was observed. Most subjects showed no "further evolution in the meditative state", that is, they did not produce the third phase of EEG change.
- (3) The third phase was found to accompany "deep meditation or even transcendence" and was characterised by a pattern of generalised fast

frequencies/

frequencies with a dominant beta rhythm around 20c/sec.

An additional finding was that in "advanced" subjects (particularly), alpha, and more rarely theta, persisted into the post-meditation periods. Topographically, the most important EEG finding was that whereas alpha rhythms spread from the occipital-parietal channels to the anterior channels during the course of meditation, resulting in a possible gradient shift, theta and beta frequencies usually appeared first in the frontal channels and then diffused posteriorly.

Banquet's (1973) findings are partially supportive and partially an extension of the earlier findings of Wallace (1970a,b), Wallace, Benson and Wilson (1971), Brown, Stewart and Blodgett (1971 & 1972), Timmonds, Kamiya and Yeager (1970) and Doxey (1972b). That is, he also reported Transcendental Meditation to be accompanied by an increase in frontal alpha and theta activity but, in addition, he reported finding a beta rhythm (which migrates from the frontal to the posterior channels) that characterizes the deepest stages of meditation. This latter finding is consistent with those of Das and Gastaut (1955) and Anand, Chhina and Singh (1961b) who found high frequency EEGs to accompany the meditations of yogis. It appears also to be consistent, although in a less direct sense, with Vassiliadis' (1972) EEG findings on Transcendental Meditation - a drop in occipital alpha from pre-meditation and an increase again after the termination of meditation. Banquet's (1973) reported findings of an upsurge in alpha in the post-meditation period is consistent with the findings of Doxey (1972b) and Vassiliadis (1972).

Banquet's (1973) study can be criticised on at least two important counts. Firstly, the experimental findings and conclusions were based upon subjective evaluations and interpretations of the EEG paper records and spectral analysis arrays of the individual subjects. No automatic analysis was used to convert this qualitative data into a quantitative form. Secondly, he failed to perform any statistical analysis on his data (which is not surprising in view of its qualitative form). It thus remains unclear whether the findings he reported are significant. Banquet also examined EEG response characteristics to flash and click stimulation during the different EEG stages of meditation. He reported finding that the alpha did not block to stimuli during Transcendental Meditation. This finding supports Anand, Chhina and Singh's (1961a)

findings/

findings on Yoga meditation but is contrary to Wallace's (1970a) findings on Transcendental Meditation. Banquet (1973) reported that the theta during Transcendental Meditation was replaced by alpha for a few seconds after the introduction of a stimulus, after which the theta returned. Finally, the beta of the deepest stages of meditation was found to be unresponsive to stimulation. It was also pointed out by Banquet (1973) that the theta and the beta rhythms of meditation had characteristics that distinguished them from the drowsy and the waking EEG rhythms respectively. This is discussed further in section 4.

A longitudinal study into the physiological and psychological effects of Transcendental Meditation was conducted by Touyz (1974). An experimental group of novice meditators were tested prior to learning meditation and at regular intervals thereafter over a period of 5 months on occipital EEG, heart-rate and skin potential. A control group of non-meditators were tested on the same physiological measures over the same time period. Cattell's 16 P.F. Inventory was administered to both experimental and control subjects at the first and the last testing sessions. The procedure for the physiological testing consisted of recording all the relevant physiological parameters over a "pre-meditation" eyes-closed rest period, a "meditation" period (in which experimental subjects meditated and the controls rested with eyes closed) and a "post-meditation" eyes-closed rest period. The EEG paper records were visually analysed and the percentage time alpha calculated. (The E was "blind" as to whether the records were of experimental or control subjects). The data were subjected to statistical analysis. Touyz reported that the occipital alpha of the experimental group decreased slightly during meditation and then showed a significant upsurge in the post-meditation rest period. These alpha changes were not found for the non-meditating control group.

Touyz's (1974) finding of a decrease in occipital alpha to accompany Transcendental Meditation is consistent with the findings of Das and Gastaut (1955) and Anand, Chhina and Singh (1961b) on yoga meditation and with the findings of Vassiliadis (1972) and (less directly) Banquet (1973) on Transcendental Meditation. His reported finding of a significant increase in alpha following Transcendental Meditation agrees with the findings of Doxey (1972b), Vassiliadis (1972) and Banquet (1973).

The most serious criticism that can be levelled against Touyz's (1974) study

is/

is that he calculated his percentage time alpha EEG data by visual subjective inspection of the EEG paper records. The validity and reliability of this subjective analysis is questionable.¹

In summary therefore, there is evidence to support the conclusion that the practice of Transcendental Meditation is accompanied by predictable and possibly significant EEG changes. There appears to be an increase in the abundance and a decrease in the frequency of alpha activity - particularly over the frontal cerebral areas. This is frequently followed by a change to theta activity; again primarily from the frontal regions as subjects "shift deeper into the meditative state" (Wallace, 1970a,b; Wallace & Benson, 1971; Brown, Stewart & Blodgett, 1971 & 1972; Timmons, Kamiya & Yeager, 1970; Doxey, 1972b). A third phase of EEG change has been described by Banquet (1973) as being indicative of a still deeper meditative state. This is a more posteriorally located beta rhythm. Indirect evidence for the occurrence of this occipital beta activity during meditation has also come from studies by Vassiliadis (1972) and Touyz (1974). It thus appears that although the frontal EEG channels during Transcendental Meditation are characterised by a slowing of the alpha activity and the occasional appearance of theta, the changes in the posterior EEG channels appear to be less clear although there is some evidence to suggest that occipital alpha may diminish (Vassiliadis, 1972 & Touyz, 1974) and that beta may increase (Banquet, 1974).

Another important finding concerns the gradient shifts in various EEG frequency bands during the course of meditation. Alpha and theta activity appear to migrate toward the frontal regions whilst beta activity may have a tendency to move in the opposite direction.

Finally, there is also evidence to suggest that post-meditation alpha levels are enhanced (Doxey, 1972b; Vassiliadis, 1972; Banquet, 1973; Touyz, 1974).

The present study aimed to investigate the occipital EEG concomitants of Transcendental Meditation using an "advanced" or experienced Transcendental Meditation group. The above review has pointed to the lack of clarity on this issue. By employing automatic EEG analysis circuitry, normalised EEG

data and/

¹ Visual interpretation of EEG sleep records are, of course, quite acceptable in view of the markedly distinctive EEG concomitants of the different sleep stages (see Dement and Kleitman, 1963; Rechtschaffen and Kales, 1973).

data and statistical analysis, it was expected that the present study would provide reliable data concerning the occipital EEG changes associated with the practice of Transcendental Meditation.

3.1.2 Blood Pressure: Bagchi and Wenger (1957) conducted a physiological study on 45 Indian Yogis over 98 meditation sessions (see section 3.1.1) and reported that "blood pressure rose minimally in a few cases, dropped 20 points systolic in 2 instances at the end (of meditation) and showed no change in others. No abnormal blood pressure was seen at any time."

The effects on blood pressure of the practice of "Shavasan", a yogic breathing exercise, was investigated in a longitudinal study by Datey, Deshmukh, Dalvi and Vinekar (1969). Forty-seven hypertensive patients were tested on blood pressure prior to learning the exercise and again after having had 30-40 weeks of regular practise at the technique. All blood pressure measurements were obtained from non-Shavasan rest periods. The experimenters reported finding that 30-40 weeks of regular practise at the technique was accompanied by an average decrease in systolic blood pressure of 20%.

In Wallace's (1970b) investigation into the physiological effects of Transcendental Meditation, technical difficulties resulted in his obtaining blood pressure data on only 5 subjects. He reported, however, that most subjects decreased slightly, although not significantly, during meditation as compared to the pre- and post-meditation rest periods.

In a subsequent study (Wallace, Benson & Wilson, 1971) into the physiological correlates of Transcendental Meditation, 36 subjects were used and it was reported that "systolic, diastolic and mean arterial blood pressure changed little during meditation" from pre- and post-meditation resting levels.

However, in a longitudinal study into the effects of Transcendental Meditation on blood pressure, Benson and Wallace (1972) reported finding significant blood pressure changes. The subjects consisted of 22 hypertensive patients from whom a total of 1 119 blood pressure samples were taken, all in the non-meditative state. Control or pre-meditation training blood pressure data were obtained prior to the subjects being instructed in meditation and after 4-63 weeks of regular practise at the technique, they were re-tested. A significant decrease in both systolic ($P < .005$) and

diastolic/

diastolic ($P < .001$) blood pressure was found. The experimenters concluded that this longitudinal decrease in blood pressure could be attributed to the regular practise of Transcendental Meditation.

A number of other studies have failed, however, to provide supportive evidence for Benson and Wallace's (1972) positive findings. Schmit (1971), for example, investigated the average blood pressures of 20 practitioners of Transcendental Meditation whose experience at the technique ranged from one month to 5 years. He found no significant correlation between length of experience at meditation and blood pressure.

Kanellakos (1973) cites Otis (private communication) as having reported finding no significant evidence for Transcendental Meditation-associated blood pressure changes in the subjective reports of practitioners. A questionnaire dealing with subjective, behavioural and physiological effects of Transcendental Meditation was sent to 1 900 randomly selected practitioners. Of the 525 people who responded to the questionnaire, the number (12) who replied positively to a question concerned with blood pressure changes (in either direction) associated with meditation was so low as not to exceed chance.

Otis, Jones and Stobert (1972) investigated blood pressure changes in 31 volunteers before their initiation into Transcendental Meditation and at monthly intervals thereafter for 6 months. No significant changes in either systolic or diastolic blood pressures were found over the 6-month period. Also, no relationship was found between the regularity of the practice of Transcendental Meditation and blood pressure changes.

Otis, Kanellakos, Lukas and Vassiliadis (1972) investigated the blood pressures of 60 normal subjects at monthly intervals for 3 months prior to and for 12 months after their initiation into either meditation or a control condition. Significant blood pressure differences between the meditation and the control groups failed to materialise over the 12-month post-initiation period.

The weight of evidence suggests therefore that the practice of Transcendental Meditation has no significant effect on blood pressure (Wallace, 1970b; Wallace, Benson & Wilson, 1971; Schmit, 1971; Otis, private communication; Otis, Jones & Sjoberg, 1972; Otis, Kanellakos, & Vassiliadis, 1972). The

one exception/

one exception was a study on hypertensive patients by Benson and Wallace (1972). A possible explanation for the failure to find blood pressure changes in the "normal" subjects has been suggested by Kanellakos and Lukas (1973) to be due to the masking effect of the "unusually low" initial blood pressures of the young meditation subjects. A significant Transcendental Meditation-associated blood pressure decrease is thus easier to demonstrate with a group of hypertensives than with a group of young meditators who have low blood pressures to begin with.

3.1.3 Respiration Rate: The respiration rates of Zen meditators have been observed by Hirai and Sugi (cited in Akishige, 1968) to decrease markedly during meditation. Similar findings have been reported by Hirai (1960), Sugi, et al (cited in Kasamatsu & Hirai, 1966) and by Onda (1965) who found that certain Zen practitioners demonstrated a decrease in respiration rate from a pre-meditation resting level of about 15 breaths per minute to about 2-3 breaths per minute during meditation. These findings have also received support from Leggett (1964) who found that the respiration rates of Zen masters dropped from a waking rate of about 15 breaths per minute to a meditation breath-rate of about 2-4 breaths per minute. (The point should be re-emphasized that unless statistical significance is specifically stated, it should not be assumed.)

Similar decreases in respiration rate have been reported to accompany Yoga meditation. Bagchi and Wenger (1957) found consistent respiration changes to accompany the Yoga meditations of 12 subjects over 16 test-sessions (see also section 3.1.1). In 9 out of the 16 sessions, the respiration rate during meditation never exceeded that during the non-meditation control period and in the other 7 sessions, the rate "... either went up minimally and transiently and later came down or remained about the same as the control period." However, the average respiration rate for the resting control periods was 16 breaths per minute whilst the lowest average respiration rate during meditation was 12 breaths per minute - an average decrease in respiration rate of 23%.

Datey, Deshmukh, Dalvi and Vinekar (1969) reported finding a decrease in the breath-rate of 47 hypertensive patients from about 22 per minute during non-exercise periods to about 8 per minute during the practice of "Shavasan" - a Yogic breathing exercise (see also section 3.1.2).

In Wallace's (1970b) study into the physiological correlates of Transcendental Meditation (see also section 3.1.3), the respiration rates of 5 subjects were determined before, during and after meditation. He reported that: "There was a significant mean decrease during meditation of about 3/min., which was maintained into the post-control period."

In the subsequent study into the physiological correlates of Transcendental Meditation, Wallace, Benson and Wilson (1971) reported finding a significant drop in the respiration rates of 5 subjects from a pre-control rate of about 13 per minute to about 11 per minute during meditation. Once again, this significant respiration rate decrease was found to persist into the post-control period.

Allison (1970) noted that the respiration rate of one "advanced" subject practising Transcendental Meditation decreased from a pre-meditation resting level of about 12 breaths per minute to about 6-8 breaths per minute during meditation. A marked reduction in respiration volume was also noted.

Vassiliadis (1972) reported finding that after an experimental group had been practising Transcendental Meditation for 4 months, their respiration rates were significantly lower than those of a non-meditating control group. Unfortunately, since no pre-meditation training respiration rate data were obtained for the 2 groups, one cannot establish whether the obtained differences were simply a function of pre-training differences between the groups.

Walrath (in preparation) also reported preliminary findings indicating that Transcendental Meditation was accompanied by a reduction in respiration rate from pre-meditation resting levels.

The evidence points overwhelmingly in favour of the conclusion that meditation, whether Zazen (Hirai, Sugi, cited in Akishige, 1968; Hirai, 1960; Sugi, et al, cited in Kasamatsu & Hirai, 1966; Ondo, 1965; Leggett, 1964), Yoga (Bagchi & Wenger, 1957 & Datey, Deshmukh, Dalvi & Vinekar, 1969), or Transcendental Meditation (Wallace, 1970b; Wallace & Wilson, 1971; Allison, 1970; Vassiliadis, 1972 & Walrath, in preparation), is accompanied by a marked and significant decrease in respiration rate.

3.1.4 Heart-Rate: The data with regard to heart-rate changes during

meditation/

meditation have been contradictory. Anand, Chhina and Singh (1961b) reported that the heart-rate of a Hatha Yogi decreased from a pre-meditation 85 beats per minute to 60-72 per minute during meditation and actually slowed to 55 per minute after the subject had been meditating for 7 hours. (This study is more fully described in section 3.1.1). Unfortunately, this uncontrolled study does not permit one to establish whether the heart-rate decrease was a function of the meditation practice, simply sitting quietly, or a combination of these two sets of factors.

Bagchi and Wenger (1957) concluded, on the basis of the findings of their research involving 45 Yogis (see also section 3.1.1), that "there were no consistent heart-rate changes during meditation compared to control periods". The heart-rate variability was reported, however, to be 6%-9% above basal levels during meditation.

Das and Gastaut (1955) reported that the heart-rate of yogis increased from about 70 per minute to about 70-80 per minute while they were practising Yoga postures and meditating and then dropped again to as low as 60 per minute afterwards. The significance of these findings, however, are rendered unclear by the study's confounding of the "physical" Yoga postures with the more "mental" Yoga meditative techniques.

A further report of enhanced heart-rate during meditation has come from Leggett (1964) who found that the pulse-rates of meditating Zen masters increased above pre-meditation levels.

Wallace (1970a,b,) investigated the physiological correlates of Transcendental Meditation. (Refer to section 3.1.1). He reported finding that the mean heart-rate of 11 subjects decreased by 5 beats per minute as compared to both pre- and post-meditation resting control periods. In a subsequent study, Wallace and Benson (1971) reported the mean heart-rate decrease during Transcendental Meditation to be in the region of three beats per minute.

Timmons, Kamiya and Yeager (1970) similarly found that the heart-rates of 8 Transcendental Meditation teachers were lowered by a few beats per minute during meditation whereas that of 8 control subjects did not change appreciably during a rest condition. Statistical evidence for the reported findings was not offered.

Vassiliadis (1972) investigated the heart-rate changes in a group of beginning meditators and a non-meditating control group after 3-4 months and after 6-9 months of meditation experience (for the experimental group). No significant differences in terms of heart-rate changes had developed between the two groups at the end of 3-4 months. That is, it was found that the decrease in heart-rate during Transcendental Meditation from pre-meditation resting levels was comparable to the decrease observed in the controls during their rest period. After 6-9 months of Transcendental Meditation experience, however, it was found that the heart-rates of the meditator group decreased by a significantly greater amount during meditation ($P < .05$) than that of the control group during their rest period.

Walrath (in preparation) also reported finding a reduction in the heart-rate of 10 subjects during Transcendental Meditation from baseline heart-rate levels.

A longitudinal physiological and psychological study into the effects of Transcendental Meditation by Simpson, Dancereau and Giles (1971) that included a heart-rate examination was inconclusive. The authors suggested that this might have been due to their meditation and relaxation control subjects failing to practise their respective techniques throughout most of the experimental periods.

A longitudinal study into the physiological effects of Transcendental Meditation on a novice meditator group was conducted by Doxey (1972b). No significant differences in terms of heart-rate were found to develop between a meditation group and a non-meditating resting control group over a period of three months.

Touyz (1974), however, in a similar long-term physiological study, reported that the meditators showed a decrease in heart-rate during meditation as compared to a non-meditating control group. Neither group, however, demonstrated a significant heart-rate change over a 5-month period. These results appear to suggest that the meditation and control groups may have differed to some extent in terms of heart-rate at the onset of the longitudinal study.

In summary, the findings with regard to heart-rate changes during meditation appear to be somewhat contradictory. Das and Gastaut (1966) and Leggett

(1964) found meditation to be associated with increases in heart-rate whilst Bagchi and Wenger (1957), Vassiliadis (1972) (for Transcendental Meditation practitioners with up to 3-4 months' experience) and Doxey (1972b) found no relationship at all, and Wallace (1970a,b), Wallace and Benson (1972), Vassiliadis (1972) (for Transcendental Meditation practitioners with 6-9 months' experience), Timmons, Kamiya and Yeager (1970), Walrath (in preparation) and Touyz (1974) found meditation to be associated with a decrease in heart-rate. However, a number of the studies that reported finding meditation to be accompanied by a heart-rate decrease failed to control for the possibility that the heart-rate reduction was simply a function of "resting".

3.1.5 Electrodermal Phenomena: Bagchi and Wenger (1957) reported finding that the palmar skin resistance¹ of yogis " ... always increased during meditation" with the median increase being in the region of 56%. Some yogis were reported to have shown skin resistance increases of up to 70% to 106% from resting levels during meditation.

Akishige's (1968) thorough review of the physiological research into Zen meditation reported that the practice was accompanied by a fall in the number of spontaneous galvanic skin responses.² It should be pointed out that this finding on a related electro dermal phenomena is in no way incompatible with Bagchi and Wenger's (1957) finding of an increase in skin resistance during Yoga meditation. Both changes are indicative of increased physiological stability or of a relative parasympathetic shift.

Wallace (1970a,b) investigated the changes in palmar skin resistance of 15 subjects across pre-control, Transcendental Meditation and post-control conditions. He reported that the changes he observed were probably the most "dramatic" physiological correlates of Transcendental Meditation. He found marked increases in the skin resistance of all subjects at the onset of meditation - "in some cases there were increases of over 500% after only 10 minutes of meditation (Wallace, 1970b)." At the end of meditation, he

reported/

¹ Skin Resistance - "Synonymous with 'Feré effect' and 'Exosomatic Skin phenomena.' Measured by the application of weak controlled amounts of electrical current to skin electrodes (Brown, 1967)."

² Spontaneous Galvanic Skin Responses - This phenomenon refers to both changes in skin potential (i.e., a measure of the electrical potential generated within the tissues) and changes in skin resistance (to a current applied externally to the skin) that do not occur within an appropriate latent period following stimulation. That is, they are not "induced" electrodermal phenomena (Elsberg; Brown, 1967).

reported, the skin resistance decreased once more to resting values. (His data indicate, however, that the skin resistance was somewhat higher during the post-control conditions than during the pre-control conditions.)

These findings were largely corroborated by the study of Wallace, Benson and Wilson (1971). They reported finding an increase from the pre-control resting skin resistance level of about 90,9 kilohms to about 234,6 kilohms during meditation. They found, however, that although the skin resistance decreased again after meditation, it still remained at a higher level than for the pre-control rest condition (at about 120 kilohms).

Orme-Johnson (1971) examined the effects of Transcendental Meditation on a number of electrodermal phenomena - GSR¹ habituation, spontaneous GSR levels and secondary GSR responses². Eight meditators and 8 non-meditators were presented with a 100 dB, $\frac{1}{2}$ second, 3000 Hz tone once every 53 seconds on average during the non-meditative state. It was found that the "induced" GSR responses of the meditators habituated to the stimuli after significantly fewer presentations (about 11) than those of the non-meditators (about 26,1). Seven subjects from each group were then measured on their resting spontaneous GSR levels and it was found that the meditators made significantly fewer spontaneous GSRs (about 8,71 per 10 minutes) than the non-meditators (about 35 per 10 minutes). Whereas the non-meditators had a spontaneous GSR frequency similar to the "normal" levels reported in the literature, the meditators had unusually stable spontaneous GSRs. It was also found that the meditators had fewer "secondary responses" in the recovery limb of their GSR fluctuations than had the non-meditators. Furthermore, a correlation of 0,73 was found between the number of spontaneous GSRs and the number of trials to criterion during extinction. A second study showed that a group of 8 non-meditators who planned to begin meditation had consistently more spontaneous GSRs than a group of 6 meditators. Once again, whilst the spontaneous GSR levels of the non-meditators were within "normal" limits, the spontaneous GSR levels of the meditators were found to be unusually stable. Orme-Johnson's (1971), not unacceptable, interpretation of his findings suggests that Transcendental Meditation is accompanied by a

stabilisation/

¹Orme-Johnson (1971) used the term "GSR" to refer to the "exosomatic skin phenomenon" or simply the "skin resistance".

²These waves are in the recovery limb of the spontaneous GSR waveform (Orme-Johnson, 1971).

stabilisation of the autonomic nervous system.

Orme-Johnson, Kielbauch, Moore and Bristol (in press) investigated personality and autonomic changes in 12 narcotic addict prisoners. The subjects were tested on spontaneous GSRs and on the Minnesota Multiphasic Personality Inventory before learning Transcendental Meditation and again 2 months later. A control group of 7 non-meditating prisoners was also tested at the same times. The results of 3 groups - regular meditators, irregular meditators and controls - were compared and it was found that the regular meditators decreased their percentage of spontaneous GSRs significantly more than did either of the other 2 groups. Furthermore, a significant correlation ($r=.74$) was found between the percentage decrease in spontaneous GSRs and the number of times that subjects meditated. The changes found on the MMPI and the relationship found between the GSR and MMPI changes are reviewed in section 3.2.4.

A reduction in the frequency of spontaneous GSRs was also reported by Walrath (in preparation) to accompany the practice of Transcendental Meditation.

The evidence from the studies reviewed in this section strongly suggests that meditation, whether Yoga (Bagchi & Wenger, 1957), Zen (Akishige, 1968) or Transcendental Meditation (Wallace, 1970a, b; Wallace, Benson & Wilson, 1971; Orme-Johnson, 1971; Orme-Johnson, et al, in press; Walrath, in preparation) is accompanied by marked and consistent changes in electrodermal activity (both in the short-term and over the long-term). The most widely corroborated finding is that meditation is accompanied by a marked increase in skin resistance (Bagchi & Wenger, 1957; Wallace, 1970a, b; Wallace, Benson & Wilson, 1971) and a decrease in the frequency of spontaneous GSRs (Akishige, 1968; Orme-Johnson, 1971; Walrath, in preparation).

3.1.6 Metabolic Rate, Cardiac Output, Oxygen Consumption, CO₂ Elimination, Blood Gases and pH: Ondo (1965) reported that Zen meditation was accompanied by a 30%-35% reduction in metabolic rate. Similarly, Sugi, et al (1964) are cited by Kasamatsu and Hirai (1966) as having found, on the basis of data on respiration rate, tidal volume and oxygen consumption, that Zen meditation was accompanied by a decrease in energy metabolism which was lower than resting metabolism. Akishige (1968) reported that the average decrease in metabolic rate during Zen meditation was 15% and sometimes even

25% below/

25% below basal metabolic levels.

Transcendental Meditation has also been described as a hypometabolic physiological state (Wallace, Benson & Wilson, 1971) characterised by sympathetic nervous system quiescence (Wallace & Benson, 1972). Further data follow related to the metabolic rate during Transcendental Meditation.

Cardiac output has been described by Kanellakos (1970) and by Kanellakos and Lukas (1973) to be an accurate index of metabolic rate since the flow rate is proportionally related to the amount of oxygen that is carried to the tissues for metabolic processes. Wallace (1970b) measured the cardiac output from 5 subjects in duplicate before, during and after meditation and reported that it " ... decreased significantly during meditation in all subjects in whom it was measured. The mean decrease after 15 minutes of meditation was about 25% from the initial control period."

Wallace, Benson and Wilson (1971) and Wallace (1970b) reported that the average total oxygen consumption of 20 subjects decreased significantly by about 40 ml./min. (or about 17%) from a pre-control resting level of about 251,2 ml./min. during Transcendental Meditation and then partially increased again during the post-control period to an average of 242,1 ml./min. This significant decrease in oxygen consumption was accompanied by a decrease of about 30ml./min. in carbon dioxide elimination (although not significant) during meditation and an increase to pre-control resting levels in the post-control resting period. However, no appreciable change in the respiratory exchange quotient¹ (i.e., from 0,77-0,90) took place during meditation. Furthermore, no significant or consistent changes in either arterial pCO_2 or pO_2 were found by Wallace, Benson and Wilson (1971) to accompany the meditations of 10 subjects. A slight but significant decrease in arterial pH was found, however, and it was concluded that Transcendental Meditation resulted in a condition of "mild" metabolic acidosis. A similar pH trend has been described to accompany Zen meditation.

Wallace and Benson (1972) suggested that since the respiration quotient remained essentially unchanged across the pre-control, the meditation and the post-control conditions, whilst the oxygen consumption and carbon dioxide

elimination/

¹The ratio of carbon dioxide elimination to oxygen consumption (in volume).

elimination decreased during meditation, the "controlling factor for both" was the reduction in the metabolic rate during meditation. This reduction was reflected in a decrease, "essentially involuntary, in the rate of respiration (off two breaths per minute)", and in a decrease in cardiac output (of about 25%).

3.1.7 Lactate in the Blood: Wallace (1970b) determined the blood lactate changes occurring before, during and after Transcendental Meditation in 2 subjects. He reported that in both cases, the lactate concentrations decreased markedly at the onset of meditation and continued to remain low after meditation.

This experiment was replicated on a larger sample of subjects by Wallace, Benson, Wilson and Garrett (1971). Blood samples were taken every 10 minutes from the brachial arteries of 8 subjects for 20-30 minutes before, for 30 minutes during and for 10-20 minutes after the practice of meditation. The blood lactate concentrations were determined by enzymatic assay. It was found that the pre-meditation lactate levels (averaging 11,4 mg%) decreased significantly during meditation (to an average of 8,0 mg%), and in the post-meditation period, not only remained low (at an average of 7,3 mg%), but actually continued to decrease slightly (to an average of 6,85 mg%). The rate of decrease in lactate concentration during the pre-meditation period averaged 2,61 mg% per hour. At the onset of meditation, this rate increased significantly to 10,26 mg% per hour.

A mechanism responsible for this marked drop in blood lactate concentration has been postulated (Wallace, Benson, Wilson & Garrett, 1971; Wallace, Benson & Wilson, 1971; Wallace & Benson, 1972). Although the relative contribution of the various body tissues toward lactate production has not been established, Wallace, Benson and Wilson (1971) cite Decker and Rosenbaum (1942) as having assumed muscle tissue to be the major source. Since there is convincing evidence to suggest that meditation is accompanied by decreased sympathetic nervous system activity and hence a decrease in the production of norepinephrine which causes the constriction of blood vessels, meditation may be expected to be accompanied by increased somatic blood flow. Indeed, this has been reported by Rieckert (1967) who found a 300% increase in forearm blood flow during meditation and by Wallace and

Benson (1972)/

Benson (1972) who found " ... a much more modest enhancement of blood flow." (Since there appears to be no consistent blood pressure changes during meditation - see section 3.1.2 - the most likely explanation for the increased somatic blood flow is in terms of a dilatation of the relevant blood vessels.) "The fall in blood lactate (may thus) ... be explained by increased skeletal muscle blood flow with consequent increased aerobic metabolism"¹ (Wallace, Benson & Wilson, 1971).

3.1.8 Skin and Body Temperature: Bagchi and Wenger (1957) reported that the skin temperature during Yoga meditation decreased by one degree C. within 10 minutes of beginning meditation.

Wallace, Benson and Wilson (1971) examined the changes in the rectal temperatures of 5 subjects before, during and after meditation. They reported finding no significant changes.

Kanellakos and Lukas (1973) cite Ritterstaedt (1966) as having reported that forehead skin temperatures of subjects practising Transcendental Meditation increased by between 0,4 and 1,6 degrees C. Although an accurate infra-red radiometer measurement technique was employed, this preliminary report gave no indication of possible temperature changes during non-meditation resting control conditions.

Holl (1971) investigated the changes in radiated skin temperature over various body areas during Transcendental Meditation by means of an "AGA Thermovision camera" which took infra-red photographs. Ten meditating and 5 non-meditating subjects were tested. He reported finding that, in general, increases in skin temperature of 0,5 -1,0 degrees C. over the throat and forehead areas and of 0,5-3,5 degrees C. over the forearm was observed. Non-meditators were simply reported to have shown "somewhat" lower temperature increases than the meditators.

Ritterstaedt and Schenkluhn (1972) examined forehead skin temperature changes in experienced subjects (i.e., with 6-10 years experience) during the practice of Transcendental Meditation by means of a temperature sensitive diode. Four subjects were tested over 15 experimental sessions. It was found that the forehead temperature increased by about 0,7-0,8 degrees C. if the meditators were well-rested prior to meditation and decreased by

0,2-0,7 degrees/

¹Lactate is a product of anaerobic metabolism

0,2-0,7 degrees C. if the meditators were tired before meditating. Kanellakos and Lukas (1973) wrote that the significance of this finding, even if repeatable, is unclear.

Arm and forehead skin temperatures of novice meditators (i.e., with less than 6 months' experience) and non-meditating controls were examined by means of thermocouples by Vassiliadis (1972). Unlike Ritterstaedt and Schenkluhn (1972) who worked with "experienced" meditators, Vassiliadis (1972) found that the forehead skin temperatures of his "novice" meditators decreased during a testing session, but he found that this decrease was significantly less than that shown by the non-meditating controls. The arm temperatures of the novice meditators on the other hand, increased during the session and this increase was greater than that of the control group ($P < .07$).

In summary therefore, although research into the relationship between meditation - particularly Transcendental Meditation - and this physiological parameter is still in the preliminary stages, a number of trends have emerged and some tentative conclusions will be presented. The preliminary evidence favours the view that both forehead skin temperature (Holl, 1971; Ritterstaedt, 1966; Ritterstaedt & Schenkluhn, 1972; Vassiliadis, 1972) (or at least decreases less than that of a non-meditating control, in the case of the last reference) and arm skin temperature may increase (Holl, 1971; Vassiliadis, 1972) during the practise of Transcendental Meditation. The significance and reliability of these findings need further to be established before their possible implications need be seriously considered.

3.1.9 Electrooculograms (EOGs): Wallace (1970b) measured the EOGs of 5 Transcendental Meditation subjects across pre-control, meditation and post-control experimental conditions and reported finding no apparent eye-movement changes.

3.1.10 Electromyograms (EMGs) and Body Motility: Das and Gastaut (1955) reported finding a complete cessation of peripheral EMG activity during the meditation of yogis even though they were sitting erect. The sensitivity of their recording equipment has been questioned, however, by Kanellakos and Lukas (1973).

Datey, Deshmukh, et al (1969) similarly found that the practise of the Yoga

breathing exercise/

breathing exercise "Shavasan" was accompanied by an almost total cessation of EMG activity.

Akishige (1968) reported that Japanese scientists had found that the muscle tone of Zen monks was only about half that of a lay control group. They further found that the duration of muscular contractions increased as a function of time elapsed into meditation. For example, after 5 minutes, the contraction-duration of the extensor communis muscle averaged 1,83 seconds, after 20 minutes, 2,23 seconds and after 40 minutes, 2,80 seconds.

Otis, Kanellakos, et al (1972) examined the effects of Transcendental Meditation on EMG activity. Although both a meditating and a control group showed a decline in EMG activity as a function of time spent in the testing session, no significant differences were found to develop between the two groups. The experimenters concluded that meditators (with 3 months' experience) exhibited only slightly greater EMG activity reduction during meditation than did a control group during a rest condition.

It thus appears that the available evidence points to the conclusion that Transcendental Meditation (Otis, Kanellakos, et al, 1972) may be accompanied by decreased muscular activity. Additional research is required, however, in order to establish both the repeatability and the significance of these findings.

3.2 Psychological Correlates of Meditation

Amongst the claims made for Transcendental Meditation by its proponents is that its regular practise leads to innumerable benefits - the most frequently reported being increased self-actualisation, increased peace within oneself, increased energy levels, loss of anxiety, relief from psychomotor symptoms, increased happiness, greater utilisation of creative potential (Otis, 1972), and an improved perception of natural phenomena (Brown, Stewart & Blodgett, 1971) due to lower perceptual thresholds (Graham, 1971). Until quite recently, none of these claims had received scientific validation and even now the number of published research articles in the area is small. Consequently, many of the studies reviewed here are unpublished papers and personal communications.

3.2.1 Perceptual/

3.2.1 Perceptual-Motor Changes: Blasdell (1971) performed a pilot study to examine the effects of Transcendental Meditation on a perceptual-motor task - the Mirror Star Tracing Task. He hypothesised that meditators would perform better at the task in terms of speed and accuracy than would non-meditators. The subjects consisted of 15 randomly selected meditators and 16 randomly selected non-meditators who were planning to learn meditation. The experimental procedure consisted of the subjects sitting for 20 minutes in a dimly lit room - the meditators were requested to meditate whilst the non-meditators were asked to relax with their eyes closed - after which they performed the task. Each subject was given 5 trials on the task and his performance was scored in terms of speed and accuracy. The results indicated that not only did the meditators generally complete the task sooner but that they also made "prettier" pictures. The meditators also claimed to be less frustrated by the task than the non-meditators. Blasdell suggested " ... that meditators are more field-independent, relying on their kinesthetic cues rather than being dependent upon the visual field. This would result in their greater ability to resolve the visual motor conflict quickly and without getting bogged down with abstract thinking about what to do." Blasdell concluded that the " ... evidence at this point supports the hypothesis that people practising the technique of Transcendental Meditation will perform more efficiently on a perceptual-motor task than those who do not. The results are inconclusive, however, as they have been evaluated subjectively and are susceptible to experimenter's bias." His findings are rendered inconclusive by yet another experimental inadequacy. The design does not permit one to establish whether the obtained differences between the two groups on the perceptual-motor task were not simple due to pre-existing differences between the two groups rather than to their practising their respective techniques. That is, no pre-meditation and pre-relaxation measures were obtained. Finally, the statistical significance of the reported findings was not stated.

Shaw and Kolb (1971) tested the hypothesis that Transcendental Meditation improves coordination between "mind and body" by means of an experiment designed to measure subjects' speed of reaction to stimuli. The experimental task consisted of having subjects respond to a light-flash by moving their hands from a resting position to press a button 20 cm away. The subjects comprised an experimental group of 9 meditators and a control group

of 9 non-meditators. Each experimental session consisted of (1) a few learning trials, (2) a block of 100 trials with the reaction-time device, (3) a 20-minute interval during which the experimental subjects meditated and the controls rested with their eyes closed, and (4) another block of 100 reaction-time trials. The results indicated that not only were the reaction-times of the meditators initially faster than those of the non-meditators (by about 30%) but also that their reaction-times improved further by about 12% after meditation whereas those of the non-meditators became slower (by about 10%) after rest. Although the author failed to give the statistical significance of these findings, Kanellakos and Lukas (1973) performed a non-parametric (the Sign Test) statistical analysis on the data and found it to be highly significant ($P < .004$). Shaw and Kolb (1971) concluded that: "It therefore seems that by practising Transcendental Meditation, the senses of the human body are sharpened and the body can react more efficiently to sensory stimulation. The individual is also brighter in mood and wit, and he is also more responsive in conversation."

Less impressive were the findings of Brown, Stewart and Blodgett (1971) who examined both the physiological (see section 3.2) and psychological effects of Transcendental Meditation. They hypothesised that performance on 4 perceptual and perceptual-motor tasks would be enhanced following meditation. The 4 tasks consisted of; (a) a two-point threshold determination of skin sensitivity, (b) visual brightness discrimination, (c) simple, and (d) complex or four-choice visual reaction-time determination (Kling & Riggs, 1971). (The results of tasks (a) and (b), being more "perceptual" in nature, are more fully described in section 3.2.2.) The subjects consisted of 11 meditators and 11 non-meditators. The experimental procedure consisted of testing subjects on the tasks prior to and after either the meditation or the control conditions. Physiological data were also monitored. Brown, Stewart and Blodgett (1971) reported that: "Statistical analysis of the results of the differences in each of the perceptual performance measures indicated no apparent significance between or within the 2 groups. Both groups improved, in general, with the post-test." This post-test improvement may be interpreted as a possible "learning effect" since the study failed to control for this variable by counterbalancing the ordering of the pre- and post-meditation tasks. These findings are, notwithstanding the above criticism, directly contradictory to those of Shaw and Kolb (1971) who reported that meditation

resulted in/

resulted in enhanced perceptual-motor ability and specifically in increased reaction-time performance.

Brown, Stewart and Blodgett (1971) then post-hoc re-analysed their data using a procedure of questionable validity. They somewhat arbitrarily selected changes in 3 physiological variables - decreased heart-rate, decreased respiratory-rate and increased frontal 8-12 Hz EEG activity - as being characteristic of "criterion meditation". Only 3 of the 11 meditators and 1 of the 11 controls demonstrated the changes that corresponded to this strict criterion. They reported that all 3 of the "criterion meditators" increased in efficiency on the 4 tasks after meditation whereas the non-meditating control who fulfilled the physiological criterion decreased in performance on 3 of the 4 tasks after rest. This data was used to support their conclusion that "criterion meditation" leads to heightened perceptual performance. However, in view of the questionable status of the concept "criterion meditation", as well as of the unacceptably small number of "criterion meditators" employed (3) and the lack of statistical backing, their conclusion appears to be founded upon questionable and inadequate data.

In summary, although all 3 of the studies reviewed concluded that their findings supported the notion of Transcendental Meditation being associated with enhanced perceptual-motor performance, 2 of the studies (Blasdel, 1971; Brown, Stewart & Blodgett, 1971) are totally lacking in conventional scientific rigour. Furthermore, in view of the fact that Shaw and Kolb's (1971) positive findings are directly contradicted by the findings of a comparable aspect of Brown, Stewart and Blodgett's (1971) study (a portion that appears to be methodologically sound), the hypothesis that Transcendental Meditation leads to heightened perceptual-motor performance may be seen to be still without acceptable scientific support.

3.2.2 Sensory-Perceptual Changes: Graham (1971) conducted a pilot study to evaluate the frequently reported subjective claim of meditation practitioners that meditation results in improved perception. The working hypothesis was "that the regular practise of Transcendental Meditation will tend to progressively lower perceptual thresholds." The experiment employed 8 subjects in a within-subjects design. The dependent variable was the subjects' acoustical frequency and amplitude discrimination thresholds. The balanced experimental design required 4 subjects to be

tested before/

tested before and after 20 minutes meditation and then later to be tested before and after reading a book for 20 minutes (control condition). Another 4 subjects had the order of the experimental and control conditions reversed. It was found that "there was a great improvement (i.e., a drop in threshold) after meditating for 20 minutes and the differences were significant ...". In a personal communication to Kanellakos (1972), Graham speculated that: "It is possible that psychological factors such as attention could account for significant changes at threshold levels. Another possibility is that neural changes are occurring in the auditory nerves or the auditory cortex ... Another possibility is the lowering of neural noise (random firing of neurons in the brain) and subsequent modification of Weber's Law." This elegant study appears to provide convincing evidence in support of the hypothesis that the regular practise of Transcendental Meditation may lower perceptual thresholds.

Brown, Stewart and Blodgett (1971) examined the effects of Transcendental Meditation on a number of perceptual-motor and sensory-perceptual parameters. The sensory-perceptual tasks consisted of a two-point threshold determination of skin sensitivity and visual brightness discrimination. The experimental method and results have already been discussed in section 3.2.1. Briefly, no significant differences were obtained between a meditating and a non-meditating group on any of the dependent variables. However, "criterion meditators" were found to show improvement on these tasks following meditation. The questionable validity of this latter finding is discussed in section 3.2.1.

Therefore, although Brown, Stewart and Blodgett's (1971) findings regarding improved perceptual performance resulting from Transcendental Meditation are somewhat questionable, Graham (1971) appears to have provided convincing evidence for a possible relationship between the practice and lowered perceptual thresholds.

3.2.3 Learning Ability and Intelligence Changes: Abrams (1972) conducted a pilot study to examine the effects of Transcendental Meditation on such learning functions as aquisition rate, toleration of interference and retention. The subjects consisted of 30 undergraduates with either no meditation experience (13 subjects), 6 months' experience (11 subjects) or less than one months' experience (6 subjects). The first experimental

session involved/

session involved the subjects learning two paired-associate lists during the presence of a "Von Restorff producing interference variable". In a second session a week later, the subjects were given a third paired-associate list to learn to criterion after which they were randomly assigned to one of 3X25-minute "interval" conditions - free recall learning, rest, or meditation (except for the non-meditators who were not assigned to the latter condition) - and finally tested afterwards for their retention of this third list. Using non-parametric statistics, Abrams found no significant relationship between the "interval" activity and retention or acquisition of paired-associates. On the other hand, a direct relationship between amount of meditation experience and acquisition rate and recall performance was found. "Generally speaking, Transcendental Meditation subjects acquired paired-associated faster than both non-meditators and beginning meditators, and recalled a higher number of paired-associates over a 25-minute and week interval." The author concluded that his data supported the contention that the benefits of Transcendental Meditation are cumulative in nature. This conclusion is, however, open to at least one important criticism. Abrams' design failed to exclude the possibility that the differences he found between meditators, beginning meditators and non-meditators were simply a function of pre-existing differences between these groups rather than a function of the cumulative effects of meditation. Since both of the meditator groups were somewhat "self-selected" or predisposed, it seems possible that these groups might have differed on at least some variables from the control subjects who "selected" not to become meditators. In other words, Abrams (1972) confounded the effects of cumulative meditation practice with subjects' predisposition to meditation.

Tjoa (1972) performed a pilot study to investigate the effects of Transcendental Meditation on measures of "neuroticism" and "intelligence". His hypothesis was that regular practise would result in lowered neuroticism (as measured on the "Neorotische Labiliteit gemetem volgens de Vragen-lystmetlode" - Wilde, 1963) and increased intelligence (as measured on the "Didderentiele Aanlegtests, Figurexrecksen" - Fokkema & Dinkzwager, 1960). A high school class of 20 subjects were tested on these two psychological instruments prior to 14 of them starting meditation and again exactly one year later. On the basis of a questionnaire, an experimental group of the 7 most regular meditators was formed and compared with a control group

comprising/

comprising 6 non-meditating subjects in the class. The results indicated that the experimental group, but not the control group, changed significantly on both "intelligence" and "neuroticism" ($P < .05$). The experimental group, although starting on a somewhat higher level of "neuroticism" than the control group, ended-up after a year on a lower level. Similarly, the experimental group, although originally lower on "intelligence", ended-up on a slightly higher level than the control group. Extreme caution is urged, however, in interpreting Tjoa's (1972) data. Firstly, his report failed to mention whether he attempted to "equate" his experimental and control subjects with respect to the "Hawthorn Effect", and secondly, the number of subjects employed was too small to have permitted him to generalise his findings reliably to the general population. Possibly in recognition of this latter shortcoming, Tjoa (1972) is currently attempting to replicate and extend the findings of his pilot study on a "much bigger scale".

Although the findings of these two pilot studies (Abrams, 1972; Tjoa, 1972) tend to indicate a relationship between long-term regular Transcendental Meditation practise and changes in learning ability/intelligence, methodological inadequacies necessitate extreme caution in making anything but the most tentative of conclusions - that there appears to be some evidence to suggest that long-term meditation practise might be accompanied by (and therefore, no direct causative relationship is implied) enhanced learning ability/intelligence.

3.2.4 Pencil-and-Paper Psychological Test Changes: Psychological research into Transcendental Meditation has frequently confounded the effects of one or more of the following factors:

- (1) Predisposed persons, that is, those who voluntarily choose to learn meditation, are invariably used as experimental subjects. This gives rise to doubts concerning the generalisability of the findings obtained on these predisposed subjects to non-predisposed populations. More specifically, would the reported "positive" psychological correlates of Transcendental Meditation accrue also to non-predisposed persons who practised the technique?
- (2) A related problem is that of comparing predisposed experimental subjects (i.e., meditators) with control subjects who are not (i.e., non-meditators)./

non-meditators). This strategy confounds "predisposition toward meditation" with other meditation-associated factors.

- (3) Since the actual practice of meditation is intimately associated with the attending of lectures and discussions provided by the International Meditation Society (especially during the earlier stages of learning the technique), practitioners are exposed to the norms and social pressures of the meditation society. A meditator thus comes under considerable pressure to behave and respond in ways corresponding to what he perceives to be acceptable to the social group. This may even include his behaviour and responses as measured on many psychological instruments. More specifically, since a meditator is under social pressure to display "positive" psychological characteristics, he may describe himself as such on psychological tests.
- (4) Since it appears possible that in many instances, simply taking the decision to begin meditation could be a contributory factor underlying changes in measurable psychological dimensions, its influence may frequently be confounded with that of other meditation-associated factors - particularly, the regular practise of meditation itself. This is simply the well-known clinical phenomenon of patients reporting "therapeutic benefits" to accompany their decision to consult a clinician or the frequently reported "cures" after only one therapeutic session (Otis, 1973).
- (5) Closely related to the above is the possible psychological effects of the meditation initiation ceremony. Once again, like "the decision to learn meditation", this ceremony could contribute toward measurable psychological changes and be confounded with the effects of other meditation-associated factors.

The first published report on the more "molar" psychological influences of Transcendental Meditation was that of Seeman, Nidich and Banta (1972). They tested the hypothesis that meditation influences, in a "positive" direction, measures derived from a widely-used inventory of "self-actualisation" - the Personal Orientation Inventory (POI) developed by Shostrom (1966). The experimental procedure consisted of administering

the POI/

the POI to an experimental group of 15 subjects prior to their beginning a programme of meditation and also to a control group of 20 subjects who did not intend to begin the practice. The experimental and control groups were found not to differ significantly on any of the 12 sub-scales of the POI on this first administration. After the experimental subjects had had two months regular meditation experience, the POI was re-administered to both groups. On this occasion it was found that the experimental and control groups differed "significantly" on 6 of the 12 sub-scales of the POI - Inner/Outer Directed ($P < .01$), Self-Regard ($P < .02$), Spontaneity ($P < .001$), Acceptance of Aggression ($P < .02$), Acceptance ($P < .01$) and Self-Actualising Value ($P < .10$). In all instances, the meditation group had moved in the predicted direction of enhanced "self-actualisation". The psychological import of these findings and implications for further study were also discussed.

Nidich, Seeman and Dreskin (in press) performed a study to replicate the above study of Seeman, Nidich and Banta (1972). Using the same experimental design, they reported that although no significant differences on the POI were found between the experimental and control groups on the first administration, after the experimental group had had two months' meditation experience, significant differences on 10 of the 12 sub-scales of the POI emerged - Inner Directedness ($P < .01$), Time Competent ($P < .05$), Self-Actualising Value ($P < .01$), Spontaneity ($P < .01$), Feeling Reactivity ($P < .05$), Self-Acceptance ($P < .05$), Capacity for Intimate Contact ($P < .05$), Acceptance of Aggression ($P < .10$), Existentiality ($P < .10$) and Self-Regard ($P < .10$). Once again, it was found that the experimental, but not the control group, had moved in the expected direction of increased "self-actualisation". They concluded that they had replicated the findings of the previous study (Seeman, Nidich & Banta, 1972).

Whilst the reliability of the findings reported by the above two studies (Seeman, Nidich & Banta, 1972; Nidich, Seeman & Dreskin, in press) appear to be acceptably high, methodological inadequacies appear to give rise to interpretation difficulties. Both of the studies concluded that: "The practise of Transcendental Meditation for a two-month period had a salutary influence on a subject's psychological state as measured by the POI". However, since the possible "salutary influences" of "the decision to learn meditation", "the initiation into meditation" and "meditation-associated social pressures" are confounded with the "two-month period of medita-

tion practise"/

tion practise", it is unclear which variable or combination of variables were responsible for the measured changes. The experimental design, in fact, does not even permit one to establish whether meditation practise per se has any measurable psychological influence at all. That is, the study provides no acceptable evidence to suggest that Transcendental Meditation has a cumulative (or time-dependent) "positive" psychological effect. Finally, even though the studies did ensure that the predisposed experimental group and the non-predisposed control group were originally equated on the relevant dependent variables (thus avoiding one of the 5 ways of confounding the data, as described earlier in this section), the fact that the experimental subjects were predisposed introduces doubt as to the generalisability of their findings to the general population (which is presumably composed largely of non-predisposed individuals).

Nidich, Seeman and Seibert (in press) investigated the influence of Transcendental Meditation on a measure of "State Anxiety" (STAI A-State Anxiety Scale). The scale was administered to a control group of non-meditators and an experimental group of meditators. Six weeks later, the subjects were subjected to a demanding task followed by instructions for the controls to "sit with eyes closed" and the experimental subjects to "begin meditation". After 15 minutes, the "State Anxiety" scale was re-administered to both groups and it was reported that meditation influenced the scale in a "positive" direction for the meditators ($P < .05$). Since no further details were provided in this pre-publication report, an adequate evaluation of their claim of having demonstrated a "State-Anxiety" reducing influence of Transcendental Meditation cannot be made. Nevertheless, the information provided is adequate to permit criticism on at least one count. Since the experimental subjects were predisposed practitioners, the generalisability of their findings to other populations is suspect.

Hjelle (in press) conducted an experiment to investigate the relationship between "Transcendental Meditation and psychological health". Employing a short-term experimental design, a group of 15 "experienced meditators" (with a mean experience of 22 months) and a group of 21 "novice meditators" (who intended starting meditation four days later) were compared on the Bendig's Anxiety Scale, Rotter's Locus of Control Scale and Shostrom's POI of "self-actualisation". The author reported finding that the "experienced meditators" were significantly less "anxious" ($P < .001$) and more "internally

controlled"/

controlled" ($P < .001$) than the "novice meditators". Furthermore, the "experienced meditators" scored significantly higher (and hence were more "self-actualised") on 7 of the 12 POI sub-scales - Inner/Outer Directed ($P < .01$), Feeling Reactivity ($P < .05$), Spontaneity ($P < .001$), Self-Regard ($P < .001$), Nature of Man Constructive ($P < .10$), Synergy ($P < .10$), Capacity for Intimate Contact ($P < .05$), Time Competence ($P < .001$) and Self-Actualising Value ($P < .01$). Hjelle concluded that these "impressive" results hold potential therapeutic implications for Transcendental Meditation. The study is subject, however, to a number of criticisms. Firstly, it is hardly correct for Hjelle to term the subjects who had not yet even learned the technique of meditation "novice meditators". They were, more correctly, simply a non-meditating control group comprised of somewhat predisposed subjects. Secondly, since no pre-training data on the two groups were available, the differences found between them might conceivably have existed prior to the "experienced meditators" learning meditation. These differences might be associated with differences in predisposition toward meditation between the "experienced meditators" and the "novice meditators". It appears probably that the "experienced meditators" were initially somewhat higher on average with respect to predisposition than the "novice meditators", many of whom were likely to abandon meditation within 22 months of learning the practice. The influence, therefore, of the variables - predisposition to meditation and the practise of meditation - are hopelessly confounded. In addition, the variables, "the decision to learn meditation", "the initiation into meditation" and "the meditation-associated social pressures" are also confounded with "the practise of meditation" and "predisposition toward meditation". It is hence somewhat unclear as to just which factor or group of factors to attribute the psychological differences found between the two groups. Finally, the study's employment of predisposed subjects casts some doubt on the generalisability of the findings to non-predisposed populations.

Ferguson and Gowan (in press) investigated the effects of Transcendental Meditation on the Cattell Anxiety Scale, the Spielberger Anxiety Inventory and the Northridge Developmental Scale, a measure of "self-actualisation" with sub-scales for "aggression", "depression" and "neuroticism". In the first part of the study, these scales were administered to an experimental group of 31 subjects 3 days prior to their beginning a programme of meditation and to a control group of 19 subjects who did not intend to learn the practice. The scales were re-administered to both groups $6\frac{1}{2}$ weeks later.

The results/

The results indicated that the experimental, but not the control group, decreased significantly on the Spielberger Anxiety Inventory ($P < .0005$), the Cattell Anxiety Scale ($P < .025$) and on "depression" ($P < .005$) and "neuroticism" ($P < .01$). Furthermore, the meditators increased significantly on "self-actualisation" ($P < .025$) whereas the controls did not. In the second part of the study, the same psychological instruments were administered to a third group of 16 "long-term" meditators and their scores were compared with those of the "short-term" meditators. It was found that the "long-term meditators" were significantly lower than the "short-term meditators" on "anxiety" as measured by both the Spielberger Inventory ($P < .025$) and the Cattell Scale ($P < .0005$) and on "depression" ($P < .01$) and "neuroticism" ($P < .005$). They were also significantly higher on "self-actualisation" ($P < .0005$). The authors concluded that: "These results indicate increased psychological health with length of time meditating. ... the present study replicates the findings of other investigators. Meditators are found not only to decrease negative personality characteristics, suggesting useful clinical applications, but they also grow in the qualities of self-actualisation found in the healthiest, most creative members of society."

This study (Ferguson & Gowan, in press) underlines again the reliability of the measurable psychological concomitants of Transcendental Meditation, but once more methodological inadequacies result in the data being open to a number of alternative interpretations. The experimental design of the first part of this study mirrors those of Seeman, Nidich and Banta (1972) and Nidich, Seeman and Dreskin (in press) and consequently shares the same methodological weaknesses and interpretation difficulties. That is, the influence of the factors, "level of predisposition to meditation", "decision to learn meditation", "initiation into meditation" and "meditation-associated social pressures" are confounded with "meditation practise". The second part of the study mirrors in design that of Hjelle (in press) and consequently shares its methodological weaknesses and interpretation problems. That is, it is unclear whether the differences found between the "long-term" and the "short-term" meditators are functionally related to their "length of time meditating" or simply to differences in predisposition to meditation of the two groups prior to their learning meditation. It may be assumed that the "long-term meditators" were initially more predisposed to meditation than the "short-term meditators", many of

whom are/

whom are likely to cease meditating before they become "long-term meditators". "Length of time meditation" and "level of predisposition to meditation" are thus confounded in the second part of this study. Finally, the generalisability of the findings from both parts of this study (Ferguson & Gowan, in press) are questionable in view of the fact that the data were obtained from predisposed samples.

Tjoa's (1972) study, in which he reported finding that high school children who had practised Transcendental Meditation for a year increased significantly on "intelligence" and decreased significantly on "neuroticism" whereas those who did not practise the technique showed no such changes, has been reviewed in section 3.2.3. Caution was urged regarding his interpretation of his results due to (1) his failure to equate his meditators and non-meditators on the "Hawthorn Effect", and (2) in view of the small number of subjects employed. His conclusions may, in addition, be criticised since his reported finding of a decrease in "neuroticism" and an increase in "intelligence" might also be attributed to a number of factors other than "the regular practise of meditation". The experimental design hopelessly confounded the possible contributing influence of such factors as "the decision to learn meditation", "initiation into meditation", "level of predisposition to meditation" and "meditation-associated social pressures" with the "regular practise of meditation". Finally, the generalisability of the findings are also somewhat suspect in view of the employment of predisposed children in the experimental group.

Fehr, Nerstheimer and Tarber (1972) investigated the effects of Transcendental Meditation on 49 teachers of meditation in Germany by means of the Freiburger Personality Inventory (FPI) - a test reported to be similar to the MMPI. The FPI, whose statistical distribution is well established in the German population, comprises 9 separate indices of "nervousness", "aggression", "depression", "irritability", "sociability", "calmness", "inconsiderateness", "tension" and "openness" (a form of lie scale). In addition, three other indices - "extraversion", "neuroticism" and "masculinity" - were developed by item analysis techniques. The subjects were divided into a group of 20 consisting of those with less than 4 years' experience at meditation (with a mean of 2,75 years) and a group of 29 consisting of those with from 4 to 11,2 years' experience (with a mean of 7,8 years). Each

group/

group was compared to a "synthetic control group" constructed from the weighted mean scores and standard deviations of the population norms matched with respect to sex and age. It was found that the first meditation group differed significantly from its "synthetic control" on only "irritability" ($P < .05$) and "inconsiderateness" ($P < .001$). In both instances, the meditators had significantly lower scores. The second meditation group on the other hand, obtained significantly lower scores ($P < .001$) than its "synthetic control" on "nervousness", "depression", "irritability", "inconsiderateness", "tension" and "neuroticism" and significantly higher scores on "sociability" ($P < .02$), "calmness" ($P < .01$) and "masculinity" ($P < .001$). The authors concluded that: "The results suggest that the changes observed may be related to the practise of Transcendental Meditation. It also appears that the longer that meditation is practised, the greater are the expected differences between meditators and non-meditators".

This short-term study, somewhat similar in design to those of Hjelle (in press) and Ferguson and Gowan's (in press) second experiment, once again demonstrates the reliability of the finding of "positive" psychological concomitants of Transcendental Meditation. However, limitations with respect to experimental design result in the data being open to a number of alternative interpretations. Possibly the most serious weakness of Fehr, et al's (1972) study lies in their confounding of the effects of the variables, "regular practise of meditation" and "predisposition to meditation". That is, the fact that the experimental groups consisted of teachers of Transcendental Meditation, an obviously highly predisposed sample, whereas the "synthetic control" groups consisted of norms drawn from a largely non-predisposed population, it follows that differences found between the groups could be attributed, wholly or in part, to differences in predisposition to meditation. The finding that the more experienced meditators demonstrated more significant differences from their non-meditating "synthetic control" group than did the less experienced meditators, may also be accounted for in terms of possible predisposition differences between the 2 meditation groups. (It may be assumed that the more experienced meditators were initially, prior to their learning meditation, more predisposed on average than the less experienced meditators, many of whom are likely to cease meditating before "qualifying" as experienced meditators.) The study has therefore failed to eliminate the possibility that the obtained differences were simply a function of differences in predisposition across

the groups/

the groups. Additional factors confounded with "meditation practise" are "the decision to learn meditation" and "meditation-associated social pressures". The authors (Fehr, Nerstheimer and Tarber, 1972) have thus failed to establish whether the psychological differences they found between the experimental and control groups were related to: (1) differences in predisposition to meditation across the groups; (2) the decision of the experimental groups to learn meditation; (3) the initiation of the experimental groups into meditation; (4) the exposure of the experimental groups to meditation-associated social pressures; (5) the actual amount of meditation experience of the experimental groups or (6) an interaction of some or all of these factors.

Landrith (1972) administered a modified version of the questionnaire used by Shelly (in press) to "assess and understand" the perceived "happiness" claimed by practitioners of Transcendental Meditation. Approximately 160 Transcendental Meditators and 145 non-meditating controls, matched for age and background, were compared on this questionnaire. On the basis of his findings, he concluded that: "Compared with non-meditators, meditators: (1) are happier and more relaxed; (2) experienced the feeling of enjoyment oftener; (3) seek social contact just as often, yet tend to spend more time alone; (4) develop deeper personal relationships and depend less on their external surroundings for happiness; (5) seek emotional arousal just as often - for example, by engaging in new activities - but tend to avoid extremes of arousal." He maintained furthermore that this evidence supports the position that meditators exhibit characteristics of self-actualised persons.

This study is open to criticism on many counts. Besides failing to offer statistical support for his conclusions, he compared predisposed experimental subjects with non-predisposed controls, hence hopelessly confounding the possible effects of "regular meditation practise" and "predisposition to meditation". Also confounded are the factors, "the decision to learn meditation", "initiation into meditation" and "meditation-associated social pressures". Finally, the employment of a predisposed experimental group casts some doubt upon the generalisability of the reported findings.

Orme-Johnson, Kiehlbaven, Moore and Bristol (in press) conducted a study

to examine/

to examine the effects of regularity of meditation on "frequency of spontaneous GSRs" (see section 3.1.5) and on scores of the Minnesota Multiphasic Personality Inventory (MMPI). Twelve narcotic addict prisoners were tested on "spontaneous GSRs" and on the MMPI prior to and again two months after beginning a programme of Transcendental Meditation. A control group of 7 non-meditators were tested at the same times. For analysis purposes, the meditators were divided into a group of 5 regular meditators (who meditated at least half the prescribed times) and a group of 7 irregular meditators. It was found that although all 3 groups decreased in spontaneous GSR frequency from the first testing (a laboratory adaptation effect), the decrease was significantly greater for the "regular meditators" than for the "irregular meditators" ($P < .0005$) or the controls ($P < .05$). Furthermore, the correlation between "regularity of meditation" and spontaneous GSR decrease was $r = .738$ ($P < .01$). Although there were initially no significant differences between the 3 groups on any of the MMPI sub-scales, it was found that the "regular meditators" decreased significantly more than the controls on "psychasthenia" ($P < .025$) and "social introversion" ($P < .05$) and significantly more than the "irregular meditators" on "psychasthenia" ($P < .05$). Orme-Johnson, et al (in press) interpreted these results to indicate that the more subjects meditate, the more they simultaneously gained in "psychophysiological stability" (as indicated by the decreased spontaneous GSR lability) and "behavioural flexibility" (as indicated by the decreased "psychasthenia"), accompanied by increased "social outgoingness" (as indicated by decreased "social introversion"). He concluded that "meditation provides a very profound physiological and psychological basis for the rehabilitation of prisoners and that the regularity of meditation is crucial to its effectiveness."

However, in view of the fact that differences in predisposition to meditation undoubtedly influenced subjects' eventual classification as "controls" (who were presumably not predisposed), "irregular meditators" or "regular meditators" (who were, presumably, initially on average more predisposed than the "irregular meditator" group), the "level of predisposition to meditation" and "regularity of practise of meditation" are hopelessly confounded. Also confounded with these 2 sets of factors across the groups are the possible effects of "the decision to learn meditation", "the initiation into meditation" and "meditation-associated social pressures". Further confounded factors include the interaction effect on "the decision to learn meditation", on

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"the initiation into meditation" and on "meditation-associated social pressures" of the different levels of "predisposition to meditation" of the 2 meditation groups. In view of these serious criticisms, Orme-Johnson's contention, that "regularity of meditation" is the crucial factor responsible for the "positive" psychological and physiological concomitants of Transcendental Meditation, appears to lack adequate experimental support. An alternative interpretation of the data may be that the psychological changes are simply a function of predisposed subjects being exposed to "the decision to learn meditation, "the initiation into meditation", and "meditation-associated social pressures". This interpretation, which is totally consistent with Orme-Johnson's (in press) data, rejects, or at least de-emphasises, the "crucial" role of "regular meditation practise" in precipitating "positive" changes on measurable psychological functions. Finally, in view of the studies' employment of predisposed prisoners as experimental subjects, the generalisability of the findings to non-predisposed populations is brought into doubt.

Five Thematic Apperception Test (TAT) pictures, Mooney Problem Check Lists and a semantic differential type questionnaire, were administered by Boese and Berger (1972) to a group of 15 subjects one week prior to their learning Transcendental Meditation and again, to 13 of them, 7 weeks later. A number of physiological parameters were also measured but due to technical difficulties these data were not analysed. The analysis of the psychological data indicated that after 6 weeks' meditation practise, the subjects had decreased significantly on the number of "problems that concerned them" ($P < .05$) and on the number of "problems that pressed them" ($P < .01$) as measured by the College Mooney Problem Check List and had decreased significantly on the TAT "hostility scale" ($P < .05$) and "anxiety scale" ($P < .133$). Significant "positive" changes on the semantic differential questionnaire were also obtained ($P < .05$). No significant changes on the Adult Mooney Problem Check List or on the TAT "human relations scale" were found. Boese and Berger concluded that even more "profound" psychological changes were likely to have been obtained had the time between the first and second psychological testings been longer than 7 weeks. They suggested that the "positive" effects of Transcendental Meditation were cumulative or "progressive".

This study, however, like most of those reviewed in this section, has con-

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founded the effects of "the practise of meditation" over a period of six weeks with the factors - "the decision to learn meditation", "the initiation into meditation" and "meditation-associated social pressures". In view of this confounding, there appears to be inadequate support for their contention that the effects of meditation are "progressive". It would appear quite possible, and not inconsistent with the data that some or even all of the meditation-associated psychological changes may have been effected within the short period of time just before and after the subjects first learned the technique. Finally, the use of a predisposed experimental group may impose restrictions on the generalisability of the findings to non-predisposed populations.

In addition to the "positive" psychological correlates of Transcendental Meditation overwhelmingly reported by the studies thus far reviewed, preliminary studies by Doucette (1971), Graham, et al, (1971) and Mac Intosh (1972) also indicate that it may be associated with salutary psychological changes. Unfortunately, the lack of information provided by these preliminary studies negates the possibility of reviewing them critically; their reported findings are therefore simply to be presented without comment.

Doucette (1971) maintained that the results of his study suggested that Transcendental Meditation had "a marked influence in lowering tension and anxiety levels in those students who had been instructed" in the proper practice of the technique. He had compared three groups; (1) naive subjects; (2) those who were trained in meditation; and (3) those allowed to practise "meditation" but not the Transcendental Meditation technique.

Four-hundred and fifty-one subjects, consisting of both long-term and newly-initiated meditators, were tested in a questionnaire-interview type study by Graham, Peterman and Scarff (1971) to examine the effects of Transcendental Meditation on personality, illegal drug use and physical and mental well-being. They concluded from their findings that the practitioners: "(1) found the technique easy and effortless to practise; (2) noticed increased clarity of mind; (3) noticed improvements in relationships with others; (4) noticed increased efficiency in action; (5) decreased or stopped abusing soft, hard and hallucinogenic drugs; (6) decreased or stopped the use of cigarettes and hard liquor; (7) attributed the above benefits to the practise of Transcendental Meditation."

Finally,/

Finally, Mac Intosh (1971) concluded from his study, that compared student meditators with non-meditators, that the former group " ... felt significantly more optimistic about (their) ability to deal with stress, manage problems, and live a more meaningful life."

In addition to the above three studies, two somewhat anecdotal reports stressing the psychotherapeutic implications of Transcendental Meditation have been published by Boudreau (1972) and by Bowers (in preparation).

The last two studies to be presented here, those of Ballou (1973) and Otis (1973), are reviewed in some depth. Due to methodological superiority over most of the other reviewed studies, they give rise to an alternative interpretation for the consistently reported finding of "positive" psychological correlates of Transcendental Meditation. Whilst neither their data nor their interpretations are incongruent with the data of the other studies, the interpretations of the other studies are inconsistent with their data.

The first study is that of Ballou (1973) who investigated the influence of Transcendental Meditation on "a measure of momentary and general anxiety" - Spielberger's Anxiety Inventory (see also Ferguson & Gowan, in press). The subjects, comprising groups at the Stillwater State Prison, were administered the scale at weekly intervals over a period of 10 weeks. After 2 weeks, they were formed into an experimental group who desired to learn meditation and received instruction, a control group who desired to learn meditation but did not receive instruction, and a second control group who were not interested in learning meditation. Ballou (1973) reported that after 8 weeks meditation, the preliminary results indicated that: "(1) Initially, there was no significant difference in anxiety levels between those who wanted to be instructed in Transcendental Meditation and those who were not interested in learning the practice. (2) Within a few days of practise, the meditating group showed significantly reduced levels of both momentary and general anxiety below those of the control groups; (3) Anxiety in the meditators does not show a gradual decline, but is reduced quickly and remains at a low level."

This study, which has employed a number of elegant controls neglected by most other studies in the area, has reported findings that suggest an

alternative interpretation for the reported "positive" psychological concomitants of Transcendental Meditation. Ballou (1973) employed both a non-predisposed and a predisposed control group as well as measuring psychological changes at regular intervals prior to and after the manipulation of the crucial independent variables - "the decision to learn meditation", "the initiation into meditation", "the meditation-associated social pressures" and "the regular practise of meditation". His results supported the conclusion that it was largely factors that converged around the time the subjects first learned the practice that were instrumental in bringing about the changes in "anxiety levels". Continued "regular meditation practise" did not appear to be a crucial factor. Although the precise statistical significance of his findings was not reported in this preliminary report, the experimental design appears adequate to limit the interpretation to the conclusion that Transcendental Meditation appears to have no cumulative effect on "anxiety", but rather that it exerts its effect around the time a subject decides to learn the practice and is first initiated into the technique. This tentative finding, although not inconsistent with the data of the previously reviewed studies, points toward an alternative interpretation for the "positive" psychological changes reported to follow from the practice of Transcendental Meditation.

Possibly the most elegant study in the field is that of Otis (1973). It was conducted in two phases. The first phase involved the administration of 2 psychological tests to a sample of 1095 subjects, all of whom had at one time been initiated into Transcendental Meditation, whether or not they were still meditating. The tests consisted of the self-constructed Physical and Behavioural Inventory (PBI) which quantified perceived changes in "behaviour", "physical health", or both, and the Descriptive Personality List (DPL) which measured perceived changes in "stable aspects of the personality". For analysis purposes, the subjects were divided into 3 groups for comparison: (1) those who had stopped meditation (after an average of 7,4 months); (2) those who had been practising for 6 months or less (average 4,2 months); and (3) those who had been practising for 18 months or more (average 22,7 months). The results on the PBI indicated that the groups differed significantly on the "degree of changes" claimed for both physical and behavioural problems, with the "experienced practitioners" demonstrating most "positive" changes and the group that stopped meditating the least change. An item analysis of the PBI indicated,

however/

however, that many items, almost all of them relating to "classical psychosomatic symptoms", were scored as equally improved by both the group that had been practising meditation for 6 months or less and the group that had been practising for more than 18 months. On the basis of this PBI data, Otis (1973) concluded that since "... a number of the changes reported by the 2 Transcendental Meditation groups ... were not time-dependent - that is, they did not depend on the length of time that the respondents had been practising meditation - we might hypothesise that these changes relate to something other than the practise of meditation". The DPL data indicated that 79 of its 250 items discriminated significantly between two or more of the groups. The apparent profile of the "experienced meditator" was that of a "kind, self-assured and easy-going human being", whilst the "novice meditators", who shared characteristics of both the "experienced meditators" and the group that stopped meditation, were "somewhat anxious, edgy persons who seek to please and try hard to succeed." The overall picture of the persons who stopped meditation was, however, more "negative" - "withdrawn, irritable and anxiety-ridden". Otis suggested that the 3 groups may have differed from each other on these particular attributes before starting meditation. "The implication is that those who start Transcendental Meditation and drop-out have (or claim) particular personality characteristics which differ markedly from those who start meditation and continue its practice indefinitely (i.e., 18 months or more ...). Our current working hypothesis is that longevity in the practise of meditation is not the crucial variable in accounting for this difference." A weakness inherent in the first phase of Otis' (1973) study is the fact that his data were derived, not from a longitudinal study, but from a single administration of the psychological tests. From the data, therefore, it is impossible to establish the validity of his suggestion that the groups were already differentiated on the PBI prior to learning meditation. In addition, longitudinal data might considerably strengthen his contention that "longevity" at meditation is not the crucial factor responsible for the "positive" psychological changes associated with Transcendental Meditation. These criticisms were avoided, however, in the second phase of the study.

One of the major aims of the second phase of Otis' (1973) study was to determine whether the benefits attributed to the practice of Transcendental Meditation by predisposed proponents would also be derived by non-predisposed

subjects who/

subjects who practised the technique. The 62 subjects in this experiment were randomly drawn from the Stanford Research Institute population and randomly assigned to either a meditation group (32 subjects) or to one of 3 control groups: (1) "passive controls" who did nothing except return occasionally for testing; (2) an "active control" who, in addition, sat quietly for 15-20 minutes twice daily, and (3) an "active control" who, besides sitting quietly also repeated a non-meditation phrase (i.e., "I am a witness only."). All subjects were tested for 3 months on physiological and psychological baselines before the meditation group was instructed in Transcendental Meditation. From this time, the meditation group and active control groups started their respective techniques and were met on an equal number of occasions. After 3 months, the PBI and DPL were administered to all subjects by mail and shortly thereafter the remaining subjects (27 meditators and 26 controls) were interviewed. For analysis purposes, the data from the 3 control groups were combined for comparison with the meditation group. The results of the PBI indicated that the meditation and control groups did not differ significantly from each other on "the number of problems claimed" nor on "the degree of changes noted". Item analysis, however, showed the meditation group to rank significantly higher on "enjoyment of life, restfulness of sleep, happiness, energy level, sexual adjustment and creativity ...". They also decreased significantly more on "fatigue". Otis (1973) posed the question that these differences might have occurred simply "as a function of time and/or the expectation that changes would occur (meditation group) or not occur (control group)? However, in view of the fact that the PBI was designed to measure changes after taking meditation, no pre-training baseline data were available on these items to provide further insight into this problem. But the DPL, which was administered at baseline, 3 months and 12 months, provided some indirect evidence. An item analysis of the DPL indicated that there were no "compelling" differences between the meditation and control groups during the 3 and 12 month test-periods that were not already present at baseline. Otis concluded that this supported the notion "that Transcendental Meditation does not alter basic personality characteristics." The results showed that those who had few serious problems (as indicated by the DPL) tended to continue with meditation whereas those who had more serious problems discontinued the practice. However, "the degree to which people who stay in Transcendental Meditation derive benefits from its practice appears to remain an open question. Transcendental Meditation had no discernible

effect on/

effect on changing self-image over the year's test-period for those people who continued its practise in the SRI experiment." Finally, the data from the structured interview 3 months after the subjects had started their respective techniques indicated that the meditators had significantly greater expectations of benefits from the procedures they were following than did the active or passive control groups from their procedures. In view of the fact that "expectancy" is known to generate a "placebo" effect, the importance of this finding is paramount. It was also found that the meditators and the active controls did not differ significantly in the benefits each group claimed, indicating according to Otis, that the procedure of simply sitting quietly - with or without a simulated mantra - had apparently beneficial effects. He concluded that "the results of the interview suggest that expectancy plays a critical role in whatever benefits accrue to an individual from practising Transcendental Meditation and that an important contributor may also be the mere practice of sitting quietly in a relaxed posture."

The second phase of the study (Otis, 1973) is methodologically superior to the majority of other reviewed studies. For example, it is the only study that, by employing only non-predisposed subjects, did not confound predisposition variables with other meditation-associated variables. This also had the effect of making the findings more readily generalisable to "normal" populations. At the same time, however, it may have resulted in the study being not directly comparable to the other studies reviewed here - studies which were all directed toward predisposed samples. Furthermore, by his strategy of administering the DPL before the subjects learned meditation, after 3 months' experience and again after 12 months' experience, Otis (1973), unlike every other researcher except Ballou (1973), was able to independently assess the role of "cumulative meditation practise" on personality change. His findings, like those of Ballou, support the hypothesis that it was not cumulative regular meditation practise that was crucially responsible for the "positive" psychological changes, but rather factors that converge around the time that the subjects first start to meditate. The importance of "expectancy" in this context has been stressed. It may be seen therefore that such factors as "the decision to learn meditation", "initiation into meditation" and "meditation-associated social pressures" (which function to systematically enhance "expectancy") appear to be crucial with respect to the psychological changes associated with the practice of Transcendental Meditation.

3.3 Mechanisms Proposed to Account for Transcendental Meditation-Associated Psychophysiological Change

3.3.1 "Stress-Release" Mechanism: "Stress-Release" or "unstressing" are descriptive terms used for a wide range of phenomena that are reported to accompany the practice of meditation (Kanellakos & Lukas, 1973). The phenomena are of a spontaneous and completely involuntary nature and include muscular movements, proprioceptive sensations and emotional changes. Furthermore, they may range in intensity from being hardly discernable to being extremely powerful and may be experienced with either positive or negative affect.

Maharishi Mahesh Yogi (1966) has theorised that they are indicative of a process during meditation whereby "stresses and strains" accumulated throughout a lifetime and stored at "deep levels" of the nervous system (equivalent to Freud's unconscious?) are "released" to the psychological and physiological benefit of the practitioner. A similar view is held by Goleman (1971) who wrote that: "The fundamental assumption in understanding the function of unstressing is, as in psychoanalytic thought, that all past experience leaves its mark on present behaviour. ... The nervous system is the repository of all experiences of emotional strain, pleasure, fatigue, tensions, stresses, etc., whether of 'physical' or 'mental' origin. In meditation ... (the) process of liberating the nervous system from past stresses is undergone without effort, volition, or intention. As the meditator reaches a level of profound relaxation and pure awareness with no thoughts, a wide range of kinesthetic sensations, vague feelings, or any of an array of psychic events can be triggered at random." It is contended, therefore, that via the process of "unstressing", Transcendental Meditation accomplishes a "purification" and "rejuvenation" of the mind and body which permits increased physiological and mental efficiency (Hartman, 1967).

A number of the phenomena of "unstressing" may be seen to resemble the "abreaction" phenomena of psychoanalysis. According to Yogi (1966), however, Transcendental Meditation goes beyond the aims of psychoanalysis of releasing "repressed" and "blocked" experience, by simultaneously "strengthening" the "mind" itself by means of the deep rest provided by the practice. In a private communication to Kanellakos (Kanellakos & Lukas, 1973), Yogi stated: "In psychoanalysis, the aim is to relive the

experience/

experience in order to become free of the symptoms produced by its exclusion from awareness and to allow repressed areas of the personality to once again participate in the conscious life of the individual. Psychoanalysis and related techniques are severely limited in their effectiveness by the fact that they do not include any means of simultaneously strengthening the mind and nervous system. These experimental attempts at improved integration are laudable in intent; however, they are proceeding on the basis of present weakness of the system and the results are therefore limited at best and can be undesirable." Within this context, Goleman (1971) considers Transcendental Meditation to be a much deeper process than psychoanalysis.

The "stress-release" theory generates a number of scientifically testable hypotheses. To the extent that they are confirmed, the theory is strengthened; to the extent that they are disconfirmed, the theory is discredited. Two of the more central hypotheses are the following: (1) Physiological and psychological changes in a "positive" direction should be functionally related to the number of years of meditation experience; (2) Highly experienced meditators who (should) experience meditation with "minimal" "unstressing" should exhibit exceptionally "positive" psychophysiological characteristics. Both the hypotheses stress the cumulative nature of the psychophysiological benefits of meditation. Although the majority of researchers in the field have concluded that the "positive" psychological and physiological concomitants of Transcendental Meditation appear to be related to cumulative or time-dependent factors, the data from which they derived their conclusions are open to an alternative interpretation. It was concluded in section 3.2.4, in fact, that factors related to cumulative meditation practise failed to account for some of the more recent experimental findings (Otis, 1973; Ballou, 1973). Should subsequent research establish the reliability of these findings, then the "stress-release" theory to account for Transcendental Meditation-associated "positive" psychological changes will be seriously discredited.

3.3.2 "Desensitisation" Mechanism: Goleman (1971) hypothesised that "meditation can accomplish the same type of behaviour change as does systematic desensitisation, and (a) change will be less immediate with meditation than with desensitisation, and (b) change will be more global with meditation than with desensitisation."

The behaviour therapy technique of "systematic desensitisation" as practised by Wolpe and Lazarus (1966) is based upon the principle that relaxation is the direct physiological opposite of "tension" and it involves 3 principle operations: (1) training in progressive relaxation; (2) the construction of a graded hierarchy of increasing anxiety-evoking stimuli, and (3) the systematic pairing of anxiety-evoking stimuli with the state of relaxation. The hierarchy is ascended from the weakest stimuli up, until even the strongest stimuli no longer elicit anxiety.

Goleman (1971) noted a number of similarities between meditation and "systematic desensitisation". First, experimental data indicated that Transcendental Meditation is accompanied by a relaxed hypometabolic state. Second, meditation is invariably reported to be accompanied by a flow of psychic events - "plannings, paranoias, hopes, fantasies, yearnings, memories, desires, indecisions, observations, fears, scheming, guilt, calculations and on and on and on" (Goleman, 1971). He hypothesised that these psychic events, drawn from the "stored pool" of the subject's total experience, comprise the meditator's "desensitisation hierarchy" - but in this instance, it is a self-regulating hierarchy. "As in the desensitisation paradigm, the hierarchy is presented coupled with the deep relaxation of deep meditation. Unlike the therapy, desensitisation is not limited to those items which the therapist and patient have identified as problematic, though these are certainly included, but extends to all phases of experience."

This theory also generates a number of experimentally testable hypotheses. Like those derived from the "stress-release" theory, however, they also stress the crucial role of the cumulative effects of regular meditation practise as being responsible for the production of "positive" psychological changes. Consequently, this theory is also incapable of adequately accounting for the experimental data of Otis (1973) and Ballou (1973) and would be further discredited to the extent that these findings receive additional support.

3.3.3 "Lactate Decrease" Mechanism: It has been experimentally established that Transcendental Meditation is accompanied by reliable and significant changes in blood lactate concentration (Wallace, 1970b; Wallace, Benson, et al, 1971). The blood lactate level drops significantly at the onset of meditation and continues to decrease throughout meditation and even for some time afterwards. (see section 3.1.7).

Wallace (1970b), Wallace, Benson, et al (1971) and Goleman (1971) have suggested that this decrease in blood lactate concentration might be a factor underlying the reported "positive" psychological effects of Transcendental Meditation, particularly the reported decrease in "anxiety" (see section 3.2.4). Wallace and Benson (1972) wrote: "Whatever the explanation of the fall in blood-lactate level, it is clear that this could have a beneficial psychological effect." This suggestion is based largely on the theory of Pitts and McClure (1967) which maintains that raised blood or body-fluid lactate levels can account for all the symptoms of anxiety. They performed a study in which they infused lactate ions into subjects and found that it sometimes produced anxiety symptoms in "normal" subjects and regularly produced anxiety attacks in patients with anxiety neurosis. Pitts and McClure (1967) and Pitts (1969) hypothesised that the excess lactate complexes with, and reduces, the ionized calcium concentration at the surface of excitable membranes to an extent that causes a disturbed nerve activity to manifest itself in the form of anxiety symptoms.

Pitts and McClure's interpretation has been severely criticised, however, by Grosz and Farmer (1969, 1972). They partially replicated Pitts and McClure's (1967) experiment using "normal" subjects (i.e., not anxiety neurotics) and additional controls. Their results indicated that the increase in "anxiety symptoms" found to accompany lactate infusion was simply a function of the alkalinising effect of the lactate and not a function of lactate per se. They found that other alkalinising agents, such as sodium bicarbonate, had the same "anxiety symptom" producing effect. They hypothesised that alkalinising agents influence "anxiety symptom" reports via their property of reducing the active ionized calcium levels on the surface of excitable membranes. On the basis of these findings and additional data, Grosz and Farmer (1972) concluded that, neither the study nor the theory of Pitts and McClure (1967) "is soundly based."

When the findings of Grosz and Farmer (1972) are considered in addition to another important and relevant empirical finding - that Transcendental Meditation is accompanied by a slight, yet significant, acidosis (Wallace, Benson & Wilson, 1971) - the theory that meditation accomplishes "anxiety" reduction by way of reduced blood lactate concentrations, may be seen to be without acceptable empirical justification. The significance of the Transcendental Meditation-associated blood lactate decrease remains thus

an open empirical question.

3.3.4 "Hypometabolic State" Mechanism: On the basis of the findings of their physiological research into meditation, Wallace, Benson and Wilson (1971) and Wallace and Benson (1972) concluded that the Transcendental Meditative state is a "wakeful hypometabolic state". This notion has received strong support from the present research review (see section 3.1).

Wallace and Benson (1972) suggested that the pattern of physiological change accompanying Transcendental Meditation (see section 3.4.1) might be indicative of "an integrative response, or reflex, that is mediated by the central nervous system", a response very much like the counterpart of Cannon's (1927) "fight or flight" or "defence-alarm" reaction. They contended further that the stress of modern society has the capacity to stimulate the sympathetic nervous system into hyperactivity which can lead to numerous physical and psychological ailments. This contention of a relationship between psychophysiological problems and relative sympathetic/parasympathetic balance has received considerable support, particularly from Marion A. Wenger. Research studies emanating from he and his associates have linked such categories as "psychoneurosis" (Wenger, 1948; Holt, 1956), and many "schizophrenias" (Gunderson, 1953; Sherry, 1959; Wenger, Clemens & Cullen, 1965), as well as numerous psychosomatic disorders (Wenger, 1948, 1962) and even "phasic anxiety" (Smith & Wenger, 1965) to relative sympathetic dominance (see review in Wenger, 1966). Wallace and Benson (1972) suggested that Transcendental Meditation might afford a method of alleviating these relatively "sympathetic" ailments via its capacity to bring about a hypometabolic shift. "In these circumstances the hypometabolic state, representing quiescence rather than hyperactivation of the sympathetic nervous system, may indicate a guidepost to better health" (Wallace & Benson, 1972).

It is suggested by the author that these proposed hypometabolism-related benefits would only materialise to the extent that the meditation-associated parasympathetic shift actually generalised to the non-meditative periods of the practitioner's lives. Unfortunately, the current weight of experimental evidence points to the conclusion that the relative parasympathetic shifts of most physiological functions during meditation are of short duration and do not persist after the termination of meditation.

This empirical finding would suggest, at least, that Wallace, Benson and Wilson (1971) and Wallace and Benson's (1972) proposed "hypometabolic state" mechanism for "positive" psychological change as a function of Transcendental Meditation is considerably less important than they have maintained.

3.3.5 An Alternative Mechanism: Recent research (Otis, 1973; Ballou, 1973) has produced evidence in support of an alternative explanatory mechanism for the Transcendental Meditation-associated "positive" psychological changes. As already mentioned, this alternative interpretation, which is totally consistent with the data of all the reviewed studies, stresses the crucial role of a number of factors that are hypothesised to converge around the time that subjects first learn the practice of meditation. The notion of the central importance of time-dependent factors is rejected on empirical grounds (Otis, 1973; Ballou, 1973) and as a consequence, the present mechanism is incompatible with those described in sections 3.3.1 to 3.3.4. The present psychological research review (see section 3.2) concluded that the currently available experimental data favoured the hypothesis that the "positive" psychological concomitants are effected within the first few weeks - shortly before and after learning meditation - and that continued regular practise of the technique thereafter has little further effect.

It is hypothesised that the following are amongst the more important factors instrumental in producing the reported "positive" psychological concomitants of Transcendental Meditation.

- (1) The predisposition of the person toward meditation. It is contended, for example, that such experiences as "initiation into meditation" or exposure to "meditation-associated social pressures" would exert different psychological effects on persons differing with respect to their predisposition to meditation. It is further contended that the effect of this kind of experience is likely to be stronger on a highly predisposed subject than on one who is disinterested in or sceptical of the practice.
- (2) The actual decision to learn meditation (see section 3.2.4).
- (3) The initiation into meditation and its accompanying ceremony (see

section 3.2.4)/

section 3.2.4). The whole ceremony appears to be geared toward the elicitation of the "standard" Transcendental Meditation "expectancies" or "mental set". The extent to which these practices achieve their objective would depend, of course, on the level of predisposition of the subject.

- (4) The meditation-associated social pressures. The norms and "expectancies" of teachers of meditation and other meditation practitioners are communicated to potential new meditators both explicitly and implicitly via literature, pre- and post-initiation lectures, "checks", and via personal communication. Furthermore, it is contended that those who voluntarily seek to learn the technique (i.e., those who are predisposed) have "expectancies" concerning the effects of Transcendental Meditation before they are initiated into the technique. This view is supported by the finding of Otis (1973) that even non-predisposed subjects have strong "expectancies" concerning benefits to be derived from meditation.

Further research is required in which each of these variables (and possibly others) are varied both individually and in interaction in order to assess their influence on psychological parameters. Finally, although positive results would not discredit the mechanism for psychological change being proposed here, further research is needed in order to establish whether the long-term practise of Transcendental Meditation has any cumulative and measurable effects.

3.4 Summary

3.4.1 Physiological Correlates of Meditation: It has been proposed that the practice of Transcendental Meditation brings about a fourth major state of consciousness, one that is physiologically distinguishable from the accepted trio of waking, sleeping and dreaming (Wallace, 1970b). The physiological activity that has been reported by researchers to index the Transcendental Meditative state has prompted Wallace, Benson and Wilson (1971) into terming it a "wakeful hypometabolic state" characterised by a parasympathetic shift in autonomic balance.

The Transcendental Meditative state appears to be accompanied by a series

of consistent/

of consistent and progressive EEG changes. As the meditative state deepens, alpha abundance increases, the average alpha frequency decreases and finally theta or even beta (with characteristics distinguishing it from waking beta) may be seen in the deepest stages of meditation. In addition, the focus of these EEG changes appears to migrate from the posterior toward the frontal cerebral regions during the course of meditation. Although there is less consensus concerning possible occipital EEG changes during meditation, what evidence there is points tentatively toward there being either no significant EEG changes or toward there being a decrease in occipital alpha accompanied by an increase in occipital beta activity (see section 3.1.1).

The Transcendental Meditative state, in comparison to the waking state, appears also to be accompanied by a decreased respiratory rate (see section 3.1.3), decreased frequency of spontaneous GSRs and a marked increase in skin resistance (see sections 3.1.5), decreased cardiac output, oxygen consumption and carbon dioxide elimination, decreased arterial blood pH levels (see section 3.1.6) and markedly diminished blood lactate concentrations (see section 3.1.7). In addition, small increases in forehead and arm skin temperature (see section 3.1.8) as well as slight decrease in EMG activity (section 3.1.10) are frequently described. On the other hand, no consistent or significant changes in blood pressure (see section 3.1.2), respiratory gas exchange quotient, arterial pO_2 , arterial pCO_2 (see section 3.1.6) or EOG activity (see section 3.1.9) appear to be associated with the practice. The position with regard to possible changes in heart-rate during Transcendental Meditation is contradictory (see section 3.1.4).

3.4.2 Psychological Correlates of Transcendental Meditation: Proponents of Transcendental Meditation contend that the regular practice of the technique leads to innumerable psychological and behavioural benefits. Only recently, however, have some of these claims received scientific attention.

On the basis of the present literature review, it would appear that the contention that Transcendental Meditation is associated with enhanced perceptual-motor performance (section 3.2.1) and increased learning abi-

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lity and intelligence (see section 3.2.3) is still without methodologically adequate scientific support. The scientific evidence in favour of Transcendental Meditation being related to heightened perceptual performance is similarly extremely tentative (see section 3.2.2).

The relationship, on the other hand, between Transcendental Meditation and psychological changes of the type measured by pencil-and-paper tests is overwhelmingly reliable (see section 3.2.4). Without exception, the studies reviewed implicated Transcendental Meditation with "positive" psychological characteristics. Amongst the most frequently reported psychological concomitants are increased "self-actualisation" (Seeman, Nidich & Banta, 1972; Nidich, Seeman & Dreskin, in press; Hjelle, in press; Ferguson & Gowan, in press), increased "happiness" (Fehr, Nerstheimer & Tarber, 1972; Otis, 1973), improved "interpersonal relationships" (Landrith, 1972; Graham, Peterman & Scarff, 1971) and decreased "anxiety" (Nidich, Seeman & Seibert, in press; Hjelle, in press; Ferguson & Gowan, in press; Boese & Berger, 1972; Doucette, 1972; Ballou, 1973), decreased "neuroticism" (Ferguson & Gowan, in press, Tjoa, 1972; Fehr, Nerstheimer & Tarber, 1972), decreased "aggression" (Ferguson & Gowan, in press; Fehr, Nerstheimer & Tarber, 1972) and decreased "tension" (Fehr, Nerstheimer & Tarber, 1972; Doucette, 1972). Since these "positive" psychological correlates have been established by different investigators, using different psychological instruments and different experimental designs, their reliability appears to be acceptably high.

The interpretation offered by the majority of writers in the field for these "positive" psychological concomitants is questioned in the present review. With the exception of Otis (1973) and Ballou (1973), the writers have maintained that it is "the regular cumulative practise of Transcendental Meditation" that is the crucial factor responsible for the obtained "positive" psychological concomitants. Otis and Ballou, on the other hand, have suggested alternative factors to be crucial in bringing about this effect. Their alternative interpretation, which implicates factors that converge around the time that subjects are first initiated into Transcendental Meditation, is consistent with all the data reviewed. The interpretations implicating "the regular cumulative practise of Transcendental Meditation" as the crucial variable on the other hand, are at a disadvantage in

accounting for/

accounting for the additional data generated by Otis (1973) and Ballou's (1973) more elegant research strategies.

It is suggested in the present review that such factors as "predisposition toward meditation", "the decision to learn meditation", "the initiation into meditation" and "meditation-associated social pressures" (all of which systematically effect "expectancy" concerning the psychological effects of meditation) converge around the time people first start to meditate and contribute significantly toward measurable "positive" psychological changes. Actual continued regular meditation practise appears to exert a far less significant effect on most measurable psychological parameters. In addition, it is suggested that when psychological characteristics are found that differentiate "experienced" meditators from less "experienced" meditators or even from non-meditators, these differences are likely to be largely a function of differences that existed prior to the learning of meditation rather than a function of the cumulative effects of meditation. There appears also to be a tendency for those subjects who lack "positive" psychological characteristics to terminate meditation.

3.4.3 Mechanisms Proposed to Account for Meditation-Associated Psycho-physiological Change: Four of the more widely accepted mechanisms proposed to account for apparent meditation-associated "positive" psychological changes are presented in the review. The first hypothesis that Transcendental Meditation brings about these changes via its tendency to "release stress from the nervous system" (Mahesh Yogi, 1966; Goleman, 1971; Kanellakos & Lukas, 1973). A second maintains that Transcendental Meditation has the characteristics of a self-regulating and global form of systematic desensitisation (Goleman, 1971). The meditation-associated fall in blood lactate level is also suggested by writers to have beneficial psychological effects (Wallace, 1970b; Wallace, Benson, Wilson & Garrett, 1971; Goleman, 1971). Finally, the hypothesised meditation-associated hypometabolic physiological state is thought by some to underly much of Transcendental Meditation's apparent therapeutic effects (Wallace, Benson & Wilson, 1971; Wallace & Benson, 1972).

The above mechanisms all stress the crucial role of factors related to the cumulative effects of regular practise as being responsible for the production of the "positive" psychological changes. They are consequent-

ly discredited to the extent that they fail to account adequately for Otis (1973) and Ballou's (1973) more recent experimental findings.

An alternative mechanism, stressing more the crucial role of non-time-dependent factors - such as "the predisposition of the subject toward meditation", "the decision to learn meditation", "the actual initiation into meditation" and "meditation-associated social pressures" (all of which influence "expectancy") - is proposed in the present review. These factors are thought to exert their major psychological effect around the time that subjects first start to meditate. This mechanism does not exclude the possibility of Transcendental Meditation also having a weaker cumulative psychological influence.

4.0 SURVEY OF THE LITERATURE PERTAINING TO THE RELATIONSHIP BETWEEN THE FEEDBACK-ASSOCIATED ALPHA STATE AND THE TRANSCENDENTAL MEDITATIVE STATE

The present chapter examines the widely held assumption that the state of consciousness associated with EEG alpha feedback is similar to or identical with that accompanying meditative techniques. It is argued that this prosthetically-induced high alpha state/meditative state identity postulate is over-simplistic and due, wholly or in part, to the use of restrictive research strategies. Too frequently, researchers have restricted themselves to doing research within a single discipline and to the employment of a minimal number of methodological operations. The research strategies that are used in the area are, of course, highly dependent upon the definitions and assumptions held, either explicitly or implicitly, by researchers concerning the nature of altered states of consciousness. These definitions and assumptions, and some of the consequences of holding them, are critically evaluated in the light of experimental findings. It is finally suggested that altered states of consciousness may, perhaps, best be defined by the use of converging operations, with data drawn from co-ordinated multidisciplinary research in which as many relevant conceptual and methodological operations as possible are concurrently employed.

4.1 The Validity of Subjective Data in Indexing Altered States of Consciousness

Tart¹ (1969) defined an altered state of consciousness for a given individual as " ... one in which he clearly feels a qualitative shift in his pattern of mental functioning, that is, he feels not just a quantitative shift (more or less alert, more or less visual imagery, sharper or duller, etc.) but also that some quality or qualities of his mental processes are different." This definition may be seen to be clearly unidisciplinary and admits only subjective data as necessary and sufficient for understanding and defining altered states. It implies that they are wholly mentalistic entities which are to be fully understood in these terms alone and that nothing is to be gained (on the psychological level) by examining the phenomena from any other disciplinary level or point of view.

The implications/

¹ This is but one of a number of definitions offered by Charles Tart and is, in fact, inconsistent with his usual methodological approach - one that places strong emphasis on co-ordinated multidisciplinary research strategies.

The implications of this kind of view are similar to those of Malcolm (1959) and Hall (1966) concerning the scientific status of dream research. Malcolm (1959) considers electrophysiological studies of dreaming to be largely irrelevant to the study of the dream as a psychological experience and advocated " ... holding firmly to waking testimony as the sole criterion of dreaming." Hall (1966) expressed similar views, feeling that we are in danger of physiologising the dream out of existence, and warned that "the night dream has been lost sight of in laboratories filled with complicated and expensive equipment."

Whilst such extreme (unidisciplinary) views do not seem characteristic of those working in the field of alpha feedback and meditation, many of these researchers have nevertheless implied a relationship to exist between the feedback-associated alpha state and the meditative states on the basis of evidence derived at least primarily from the subjective level of analysis. Rarely has the veracity of this subjective data been questioned. Opinions concerning the relationship between these states range from those suggesting them to be identical to more cautious and tentative suggestions of similarity between the feedback-associated alpha state and the earlier stages of meditation. Nideffer (1973), for example, wrote that "the descriptions of what subjects said they felt like in the alpha state resembled the feelings which are said to accompany meditative states. The relaxed 'non-critical' attitudes of Kamiya and Brown's subjects correspond quite closely to the ego loss and relaxed, non-critical mergence of mind and body described by Zen and Yogic meditators." Stoyva (1970) similarly reported that the subjects Kamiya (1969) recruited with considerable meditation experience " ... not only learned the alpha task very readily but reported that the alpha state was very similar to certain mystical states." Swami Rama, an Indian Yogi, after having been given a number of alpha feedback sessions at the Menninger Foundation, offered a more cautious statement on the relationship between these states on the basis of his subjective experience. "His attitude about biofeedback was that it would accelerate the training of young yogis up to the point where machines could no longer follow" (Green, 1971). He appeared therefore to have subjectively identified a relationship between the feedback state and the earlier stages of meditation.

A number of theoretically-based arguments as well as experimental evidence

follow/

follow to support the conclusion that data from the subjective level of analysis alone are of questionable validity in defining altered states of consciousness.

Although many of the people who have experienced both meditation and alpha feedback have reported their experiences to be similar or even identical, it is contended that their testimony to this effect may be explained so as to de-emphasize this evidence. For most people, any deviation from the "normal" states of consciousness is such an intensely unique experience that not only do they lack the necessary language skills to communicate about their experiences, but also the necessary perceptual and discriminatory (or conceptual) skills to differentiate between what might be, for persons familiar with these experiences (and thus possessing the necessary conceptual skills), completely distinct phenomenal states (Doxey 1972a). Both Kamiya (1969), in describing the subjective reports of his alpha feedback subjects, and Ludwig (1966), in writing about altered states of consciousness in general, stressed the ineffability of these experiences.

The difficulty encountered in verbalising and describing altered states may also be understood within the framework of Deikman's (1966) "deautomatization" theory of mystical experiences. He hypothesized that mystical phenomena are a consequence " ... of a deautomatisation of (the) psychological structures that 'organise, limit, select and interpret perceptual stimuli,'" and that " ... one would expect deautomatisation to result in a shift toward a perceptual and cognitive organisation ... preceding the analytic, abstract, intellectual mode typical of present-day adult thought." The occurrence of altered states of consciousness against a background of an aconceptual mode of cognition might contribute toward their reported ineffability.

Ornstein (1972) proposed a theory that goes beyond that of Deikman (1966) by transposing much of what Deikman conceptualised in terms of "deautomatisation" to another level of explanation in terms of a shift toward a mode of cognition that is characteristic of right cerebral hemisphere function. Right hemisphere psychological functions have been described by Bakan (1969) to be "preverbal, pre-logical, subjective, intuitive, global, synthetic and diffuse". It is hence hardly surprising that subjects experience such difficulty in attempting to verbalise or even think

about/

about phenomena that they experience in states that are hypothesised to be preverbal and pre-conceptual.

A further problem encountered when assessing subjective reports of altered states is the frequent tendency for people to develop varying degrees of amnesia for their experiences. The memory of altered state material appears to have a very short half-life. This finding may be understood within Fischer and Landon's (1972) theory of "stateboundness". They hypothesise that the retrieval of a particular experience is optimal only at that "level of arousal" (or state of consciousness) which corresponds to the level of arousal prevailing during the initial experience. It follows that after a subject has shifted from an altered state back to his "normal" waking state of consciousness, his ability to retrieve altered state material will be diminished. Referring specifically to the susceptibility of the subjective experiences of the alpha feedback state to this effect, Fischer and Landon wrote that "the most technically advanced device for establishing statebound experience is the learned induction and control of a particular level of arousal through bio-feedback."

Even within the area of hypnosis, there is considerable doubt as to the validity of subjects' testimony concerning their hypnotic experiences. Tart and Hilgard (1966) appear to assume that a close relationship exists between subjects' testimony concerning their experiences in the hypnotic state and their actual experiences. They state in fact that a "subject's report that he feels hypnotised to some degree are primary data about the presence or absence of hypnosis, if not a criterion of hypnosis." Orne (1966, 1967), however, although also an adherent of the traditional trance hypnosis paradigm, does not support this view. He suggests instead that a subject's testimony about a hypnotic experience is a function of, not only "the essential characteristics of the hypnotic trance state", but also of the perceived "demand characteristics" of the whole situation. Changes in these demand characteristics can therefore bring about alterations in a subject's verbal testimony concerning his hypnotic experiences in the absence of any actual change in these experiences per se. Barber (1969), the main spokesman for the alternative non-trance "hypnosis" paradigm, appears to hold similar views, in this context, to those of Orne (1966, 1967). He has been able to denote objective antecedent variables (corresponding roughly to Orne's "demand characteristics") which can be shown to relate

empirically/

empirically to the subjects' testimony concerning their "hypnotic" experiences. It follows therefore that the manipulation of these antecedent variables might result in changes in testimony about "hypnotic" phenomena in the absence of actual changes in the intervening "hypnotic" phenomena.

Perceived demand characteristics and/or a large number of antecedent variables undoubtedly also influence subjects' testimony concerning their alpha feedback or meditation experiences. For example, a difference in "attitude" (one of Barber's antecedent variables) may result in the same altered state phenomenon being described in "negative" terms as "losing contact with reality" or in more "positive" terms as "an inward shift of awareness". The strength of the argument against the validity of using subjective data, and especially of using it alone, in evaluating altered state phenomena, is further enhanced when it is realised that the subjective data are invariably hopelessly confounded with these factors.

An additional complication arises out of the fact that whereas the various meditative techniques are usually taught within the framework of a particular philosophy, alpha feedback researchers have generally endeavoured to employ naive subjects. The net result of this is that in the meditation situation the antecedent variables are at least to some extent known, manipulated and common to all practitioners. In the alpha feedback situation on the other hand, the antecedent variables are usually unknown, not manipulated and consequently highly variable across subjects. In the light of this argument, comparisons between the meditative states and the alpha feedback state on the basis of subjective reports, particularly if used alone, may be seen to assume even less validity.

The majority of writers on meditation and alpha feedback have suggested a close relationship to exist between these two hypothetical altered states, not simply on the basis of data obtained at the subjective level, but also on the strength of additional evidence derived from the electrophysiological (particularly the EEG) level of analysis (Kamiya, 1968, 1969; Mulholland, 1968; Maslow, 1969; Hilgard, 1969; Stoyva, 1970; Hart, 1967; Lynch & Paskewitz, 1971; Davidson & Krippner, 1971; Gaarder, 1971; Black, 1971, 1972; Ornstein, 1972; Shapiro & Schwartz, 1972; Nideffer, 1973). These

suggested/

suggested relationships, based as they are on evidence from at least two levels of analysis, are a consequence of a methodological approach more consistent with Tart's (1969) behaviouristically worded altered state of consciousness definition as a "hypothetical construct invoked when a subject's behaviour (including the behaviour of the verbal report) is radically different from his ordinary behaviour."

Once again, opinions concerning the relationship between these states range from those suggesting near-identity to those tentatively suggesting the possibility of a far more limited relationship. Hilgard (1969), for example, in suggesting that a fourth state of consciousness be added to the accepted trio of waking, REM sleep and Non-REM sleep, described this state as one which people " ... can learn to control in the laboratory, or in certain kinds of exercises, as under a Zen master." Maslow (1969) similarly wrote that "Kamiya discovered quite fortuitously that bringing the alpha waves to a particular level could produce in the subject a state of serenity, meditateness, even happiness. Some follow-up studies with meditators show that they emit EEGs that are like the serene ones to which Kamiya was able to educate his subjects. That is to say, that it is already possible to teach people how to feel happy and serene."

Davidson and Krippner (1971) suggested that feedback instrumentation could help people attain meditative states but cautioned that it should never be thought of as "instant Zen" but rather that it should be conceived as " ... a crude attempt to enable Western man to place his physiology in a receptive state that will more easily allow his psychology to be altered." Ornstein (1972) equally cautiously warned that "although some writers have given the impression that electric Zen is just around the corner for all, this prophecy will be fulfilled (if at all) after years of research. The current developments in feedback training are hardly in the same league with the procedures of the esoteric traditions."

Possibly the most important reason for wanting to compare alpha feedback training and meditation is to determine whether the psychotherapeutic, physiological and other benefits that have been reported to accompany meditation (see section 3), also accompany the regular practise of feedback for alpha enhancement. This would follow, of course, were the alpha feedback state/meditative state postulate true. Nideffer (1973) wrote that

" ... since

" ... since the meditative states are associated with a high production of alpha and since normal subjects report some of the subjective feelings of the meditators, it has been automatically assumed that control over alpha leads to ..." the same beneficial effects that are said to accrue from meditation.

The practitioners of Yoga, Zen and Transcendental Meditation (and even Autogenic Training), as well as a number of recent scientific reports (see section 3), have suggested that these practices have intrinsic value. Due to the purported similarity between the feedback-associated alpha states and these meditative states, individuals and private enterprises are offering courses in alpha training, promising such benefits as an "instant Zen experience", more rapid learning, increased interpersonal happiness, development of ESP, and control over body physiology and disease processes to accrue from this training (Nideffer, 1973). However, as has already been indicated, these claims are being made not on the basis of research into alpha feedback training, but rather on the strength of the somewhat questionable assumption of high alpha/meditative state identity. A study in which Gannon and Sternbach (1971) attempted to attenuate pain by providing alpha feedback was based upon this kind of reasoning. They reasoned that since Anand, Chhina and Singh (1961b) had reported raised pain thresholds in some yogis, a similar effect may also accompany feedback-associated alpha enhancement. (Their findings were largely negative.)

It is clearly a matter of some urgency that the question of the relationship between these states be directly examined. Gaarder (1971), Black (1972) and others have advocated the need for research into this problem.

4.2 The Validity of Physiological Data in Indexing Altered States of Consciousness:

The questionable validity of employing subjective data for the indexing of altered states of consciousness has already been discussed. A critical evaluation of the validity of using EEG and other physiological parameters for the purpose follows.

The similarities between the EEG changes accompanying Yoga, Zen and Transcendental Meditation have frequently been described as quite striking. All three meditative practices are reported to be accompanied by increases

in the/

in the abundance and amplitude of alpha activity. In addition, a slowing of the average alpha frequency and the appearance of theta have frequently been reported to characterise the deeper stages of Zen and Transcendental Meditation (For a more detained survey of the EEG correlates of meditation, see section 3.1.1).

Since the apparently similar EEG changes that accompany these three differently-named meditative states are supported also by similar subjective reports, it should follow logically that those writers who have been prepared to suggest a relationship between the feedback-associated alpha state and "the meditative state", should also be equally prepared to suggest a relationship between these meditative states. That they have not made this suggestion is due not to EEG or subjective evidence, but rather to data obtained from the application of additional methodological operations. These additional research strategies have revealed important differences to underly the apparently similar EEG concomitants and subjective reports. The application of the additional methodological operation of determining the response characteristics of the EEG has revealed clear differences between the three meditative states. Zen monks, it was found, fail to demonstrate the usual alpha blocking response to stimulation; that is, unlike "normal" subjects, their EEG blocking response to click stimulation fails to show habituation, even to the repeated presentation of this stimulation (Kasamatsu & Hirai, 1966). The yogis too, show a response that is unlike that of a "normal" waking subject. During their Somadhi meditation, they fail to show any EEG response at all to stimulation. Nevertheless, when not meditating, these same yogis not only demonstrate alpha blocking, but, like the Zen when they are meditating, fail to show any habituation of the alpha blocking response to repeated stimulation (Anand, Chhina & Singh, 1961b). Wallace (1970b) examined the EEG response characteristics of meditating Transcendental Meditators and reported finding no habituation of the alpha blocking response to repeated stimuli, a finding similar to that reported for Zen by Kasamatsu and Hirai (1966). Banquet (1973) on the other hand, reported finding not an absence of habituation during Transcendental Meditation, but instead, an absence of alpha blocking itself - a finding more in line with that of Anand, Chhina and Singh (1961b) on yogis. The findings therefore with regard to the EEG response characteristics of Transcendental Meditation are still contradictory (see section 3.1.1).

It appears/

It appears therefore that on the evidence of the EEG response characteristics, a clear distinction may be made between the Zen meditators on the one hand, who respond to stimuli during their meditation but fail to demonstrate habituation to repeated stimulation, and the Yoga meditators on the other, who simply show no blocking response at all to stimuli presented during their meditation. On the application of yet another methodological strategy (at a different level of analysis), even more differences are found to emerge. Whilst the yogis "generally claimed to be oblivious to their external and internal environment" during their Somadhi meditation (Anand, Chhina & Singh, 1961b), the Zen reported that they had "more clearly perceived each stimulus than in their ordinary waking stage" (Kasamatsu & Hirai, 1966). Transcendental Meditators similarly reported perceiving both internal and external stimuli during their meditation (Banquet, 1973).

In summary therefore, the apparent superficial similarity between the EEGs and the subjective testimony of the practitioners of these 3 differently-named meditative states were shown to be accompanied by marked differences with respect to response characteristics a (methodological operation) at both the EEG and the verbal report (or subjective) levels of analysis. The Zen were reported to demonstrate alpha blocking to stimuli without habituation whilst maintaining enhanced awareness of stimuli; the yogis were reported to demonstrate neither alpha blocking to stimuli nor subjective awareness of stimuli during their meditation, whilst the data with respect to Transcendental Meditation were contradictory. As more methodological operations were introduced, differences between the meditative states became increasingly evident. It seems reasonable to expect that the application of similar methodological strategies might succeed also in breaking the apparent relationship between the feedback-associated alpha state and the (themselves different) meditative states.

It is of interest to note that the differences described above are consistent with differences between these states at a philosophical level. Tart (1969) suggested that the "Zen monks are striving to exist in the here-and-now, in the immediacy of the phenomenal world; thus if one interprets the adaption to stimuli seen in ordinary subjects as the substitution of abstract cognitive patterns for raw sensory experience, the Zen are apparently managing to stay in the here-and-now of immediate sensory experience. Yoga philosophy, on the other hand, has a strong world

denying quality/

denying quality, a belief that the phenomenal world is all illusion and ensnarement (maya), which the yogin must learn to transcend. Thus it makes sense that they show no EEG response to stimulation and also report being unaware of the stimulation after the meditative state is terminated."

Comparisons between "the meditative state" and the feedback-associated alpha state at levels of analysis other than those of the EEG and verbal report, appear to hold the possibility of distinguishing between the states. For example, Wallace (1970b) found the practice of Transcendental Meditation to be unaccompanied by changes in eye-movements (see section 3.1.9). On the other hand, according to Mulholland's (1968, 1969a, b, c) "efferent oculomotor theory" of alpha, quiescence of the oculomotor system is a necessary, although not sufficient, condition for the presence of alpha. Feedback directed toward the enhancement of alpha would therefore be expected to be accompanied by decreased EOG activity.¹ This theoretical prediction has been confirmed, in fact, by Honorton, Davidson and Bindler's (1972) finding that feedback for alpha enhancement was accompanied by significantly less REM (Rapid Eye Movement) activity than was feedback for alpha suppression (see section 2.2). An earlier preliminary observation by Kamiya (1962) failed to find a relationship between eye-movement activity and alpha changes (see section 2.1). It may thus be tentatively concluded that although no evidence appears to exist for a relationship between EOG changes and Transcendental Meditation, both theoretical and experimental evidence suggest that feedback-associated alpha enhancement may be accompanied by diminished EOG activity.

It seems thus reasonable to expect that the extension of the comparative examination to additional levels of analysis may prove fruitful in breaking the apparent relationship between the feedback-associated alpha state and "the meditative state".

Further arguments in support of the conclusion that physiological data (alone) are of questionable validity in defining altered states of consciousness follow.

The "psychophysiological/

¹A notable exception is provided by Dewan's (1967) study in which subjects learned to enhance their alpha by means of "active" eye-elevation. This strategy should be distinguished from the "passive" techniques employed by the other studies reviewed in section 2.

The "psychophysiological principle" (Green, et al, 1970) states that: "Every change in the physiological state is accompanied by an appropriate change in the mental-emotional state, and conversely, every change in the mental-emotional state, consciously or unconsciously, is accompanied by an appropriate change in the physiological state." A naive application of this principle to the psychophysiological study of consciousness has led to many fallacious assumptions concerning the relationship between psychological and physiological function during different states of consciousness. It has, for example, been suggested that the presence of particular altered states may be indexed by the presence of relevant physiological changes. Fischer (1971) has mapped states of consciousness, ranging from the ecstatic to Yoga Somadhi, on a perceptual-hallucination continuum of increasing ergotropic arousal from "normal" to ecstatic and increasing trophotropic arousal from "normal" to Yoga Somadhi.

Whilst Cannon (1927) many years ago asserted that the same visceral changes can occur in very different emotional and even non-emotional states, only recently has the question been posed: "Can the same visceral changes occur in very different states of consciousness?" (Johnson, 1970). Johnson, on the basis of his survey of EEG and autonomic activity found across different states of consciousness, concluded that the same visceral changes can, indeed, occur in different states of consciousness. For example, the EEG alpha activity which is accepted as being indicative of a relaxed waking state is found also during the REM stage of sleep. In terms of response characteristics, however, this REM alpha activity is clearly distinguishable from waking alpha. A further example is provided by the difficult problem encountered in trying to distinguish between the waking, drowsy and REM sleep patterns of subjects who have low voltage EEGs. Lubin, Johnson and Austin (1969) reported that this situation can confuse, not only humans, but even computers. The theta and beta activity that Banquet (1973) reported finding in the deepest stages of Transcendental Meditation was described as being different from these rhythms when seen in the sleep (or drowsy) and waking states respectively. He wrote of the theta rhythm of meditation that, in response to click stimulation, it " ... changed into the alpha rhythm of an arousal reaction, therefore the rhythmic theta train of meditation has a reactivity similar to the waking alpha rhythm." The low voltage fast activity of the deepest stages of meditation was found to be distinguishable from waking beta by appearing

against a/

against a background of slow frequencies. These findings may be seen to be consistent with Black's (1972) contention that "... a given pattern of neural electrical activity could function in different neural systems, and different patterns could play the same role in a given neural system." On the basis of his evaluation of a wealth of evidence of a similar nature, Johnson (1970) concluded that EEG and autonomic activity cannot alone be used to define states of consciousness.

Although the psychophysiological principle is probably quite valid axiomatically, its validity, in application to altered states of consciousness, appears to be undermined by practical problems. The major problem is that the presently available technology does not enable one to assess really "appropriate physiological changes". Even the EEG, our primary physiological index of consciousness, is a "somewhat poor instrument for studying the most complex organ in the world" (Ornstein, 1972).

It appears possible (should one assume a "cerebral-origin" approach to the EEG) that the same EEG activity seen during different states of consciousness could arise from different "brain wave generators." Computer studies conducted by Johnson (1970) of the EEG coherence during different sleep stages suggest that the 8 to 12 Hz alpha waves seen during these different sleep stages might not necessarily originate from a single "alpha generator". So perhaps there may be more than one source for similar waves (as recorded from the surface of the scalp). Could perhaps the source determine the EEG response pattern? It seems possible that the apparently similar alpha waves found in different meditative states might originate from different alpha generators, that is, from functionally and anatomically distinct parts of the brain (Doxey, 1972a). In comparing Transcendental Meditation and feedback-enhanced alpha states, this possibility becomes even more plausible. During the course of meditation, there is a forward shift in the focus of alpha activity from the occipital to the central and frontal regions of the brain (Wallace, 1970a, b; Banquet, 1973). During alpha feedback on the other hand, the feedback has invariably involved either the occipital or the parietal regions and there have been no reports of alpha intensity shifts away from these regions (see section 2).

4.3 An Alternativist-Multidisciplinary Approach to the Study of Altered States of Consciousness

Evidence has been/

Evidence has been presented thus far in support of the conclusion that not only are subjective data of questionable validity in defining altered states of consciousness, but also that the best available physiological evidence falls far short of being an adequate criterion. These conclusions are consistent with the view that "consciousness" may be neither fully understood within the frameworks of physiology nor psychology; that the essence of what consciousness is transcends the limiting conceptual constraints of either of these disciplines. Nevertheless, even though the essence of the phenomenon of consciousness may forever elude us, it is felt that simultaneous data derived from different levels of analysis and from different theoretical frameworks might converge to provide a more valid partial knowledge of the phenomenon. William James (1971), in 1901, expressed not only similar views concerning the nature of consciousness, but also advocated a similar approach to its understanding. He wrote: "And why, after all, may not the world be so complex as to consist of many interpenetrating spheres of reality, which we can thus approach in alternation by using different conceptions and assuming different attitudes, just as mathematicians handle the same numerical and spacial facts by geometry, by analytical geometry, by algebra, by the calculus, or by quaternions, and each time come out right?"

This kind of assumption as to the essential nature of consciousness demands a very specific kind of methodological approach to the scientific study of the phenomenon. The approach adopted in the present study may perhaps best be described as "alternativist" and "multidisciplinary". Meta-theoretically, it has its origin in the writings of physicist P.K. Feyerabend (1967) whilst its translation into a viable scientific research strategy is a result of the writings of Garner, et al (1956), Stoyva and Kamiya (1968) and Stoyva (1970). In terms of this approach, an altered state of consciousness is seen as a hypothetical construct which can be best understood by the simultaneous use of converging operations from many relevant levels of analysis as well as from many relevant methodological strategies within these disciplinary levels (see section 1.3). Both Hilgard (1969) and Johnson (1970) have expressed views consistent with this approach whilst Mason's (1970) suggested approach to the study of psychosomatic problems, in terms of a multidisciplinary research effort in which as many conceptual and methodological approaches as possible be concurrently employed, seems equally applicable to the scientific study of

consciousness/

consciousness.

The methodological strategy of converging operations has been described by Garner et al (1956) as " ... any set of two or more experimental operations which allow the selection or elimination of alternative hypotheses for concepts which could explain a given experimental result. They are called converging operations because they are not perfectly correlated and thus can converge on a single concept." Stoyva and Kamiya (1968) and Stoyva (1970) have shown both the REM indicator and verbal reports to be far from perfect indices of the hypothetical internal state of dreaming. However, by using converging and overlapping observations from the verbal and physiological levels simultaneously, they have been able to enhance the construct validity of the hypothetical dreaming state. They advocate the application of this approach to the scientific study of other altered states of consciousness - including the feedback-associated alpha state and the meditative states.

In the present study, the method of converging operations was adopted in order to obtain decisive evidence on the question of the relationship between the hypothetical feedback-associated alpha and Transcendental Meditation states. The two practices were thus examined and compared across a number of different disciplinary levels and across a number of different methodological strategies situated at these levels.

In addition, unlike previous writers who have tended to base their conclusions concerning the relationship between the two states upon data derived by different researchers using different experimental procedures, an attempt was made in the present study to compare the practices across constant experimental techniques. An example that possibly best illustrates the questionable validity of these previous attempts is the following. Without exception, the alpha feedback studies reviewed in section 2 were concerned with the manipulation of occipital EEG activity. More specifically, none of the studies that were accepted as having successfully demonstrated the phenomenon of operant alpha enhancement (see section 2.4.1) employed frontal EEG channels. It would appear extremely unlikely that feedback-associated changes in occipital abundance would produce the kind of forward migration of slow wave EEG activity that is reported to accompany Transcendental Meditation (see section 3.1.1). This view has received some support from

studies by/

studies by Hord, Naitoh and Johnson (1972) and Naitoh, Johnson and Tracey (1972) who investigated the phase-angle relationship between occipital, temporal and frontal EEG leads in 6 subjects who had demonstrated "an ability to self-regulate (their occipital) alpha in an operant conditioning experiment." They reported finding that although there was some degree of coherence between the occipital and the frontal EEG leads (with the frontal lagging the occipital by about 42 msec.), there was little evidence for an increase in the intensity of frequency ranges other than the specifically reinforced alpha range. Thus, although feedback-associated changes in occipital EEG rhythms did exert an influence (later) on frontal rhythms, this influence was limited to the alpha frequency range and in no way resembled the typical Transcendental Meditation EEG pattern - low frequency alpha and sometimes theta activity concentrated largely over the frontal regions with possible decreases in alpha and increases in beta over the occipital areas. It would appear essential that when comparing the EEG changes associated with the two practices, more attention be directed toward the topographical distribution of these changes. Thus, although both Transcendental Meditation and occipital alpha feedback are usually associated with increased alpha abundance, the former technique appear to bring about changes largely over the frontal regions whilst the latter technique seems to be associate with largely posteriorally located and more limited EEG changes.

In order to avoid many of the indicated problems associated with previous attempts to compare the two states, the present study examined their relationship by means of a systematic comparative examination of some of their supposed concomitants (using constant experimental techniques).

5.0 METHODOLOGY

5.1 Subjects

The subjects in the present study comprised 72 volunteers drawn from approximately the same socioeconomic and educational background (i.e., the majority were students or former students of the University of Cape Town). They were all English speaking Caucasians and ranged in age from 16 - 36 years. In no instance was obvious physical or mental "abnormality" observed. The subjects were distributed across the following 3 groups:-

5.1.1 Alpha Feedback Group: This group consisted originally of 21 subjects - 11 females and 10 males. One male subject, however, was forced to withdraw from the study after 4 weeks as a result of hospitalisation. His data were thus excluded from the analysis. The remaining 20 subjects, with a mean age of 24,8 years and an age range of from 19 - 36 years, participated in the longitudinal study on a volunteer basis. They were, however, to a limited extent, aware of some of the broader aims of the study. That is, they were told that the study was directed toward the investigation of possible physiological and psychological concomitants of 6 weeks regular alpha feedback practise. Furthermore, largely as a result of the extensive press coverage given to the phenomenon, they were not naive as to the nature of alpha feedback training. However, lest this be considered a weakness in the present study, it should be mentioned that even after they had had a week's exposure to the experimental situation for the establishment of "pre-training or baseline" data prior to receiving feedback training, they were clearly incapable of demonstrating "differential alpha control" (see sections 2.2 & 5.3.1). In fact, when the subjects were instructed to either "enhance" or "suppress" their alpha levels, their efforts invariably gave rise to responses opposite to that requested (see Appendix J). The subjects' limited prior knowledge concerning the phenomenon of alpha feedback had, therefore, no appreciable effect upon their ability to control the rhythm.

For the purpose of statistical analysis, the alpha feedback group was subdivided into "successful" and "unsuccessful" subgroups according to a

number/

number of different criteria of "success" at alpha feedback training. This procedure is described in section 5.6.1.

5.1.2 "Advanced" Transcendental Meditation Group: This group comprised 10 subjects - 6 males and 4 females - with a mean age of 23,3 years and an age range of from 19 - 34 years. They were all teachers of Transcendental Meditation who had received instruction in the technique under the personal supervision of the Maharishi Mahesh Yogi. At the time of testing, they were attached to the Transcendental Meditation Centre in Cape Town. Their experience at meditation ranged from 2 - 6 years with a mean of 2,75 years (i.e., S1 - 6, S2 - 3, S3 - 2,5, S4 - 2,5, S6 - 2, S7 - 2, S8 - 2, S9 - 2,5 and S10 - 2,5 years respectively).

5.1.3 "Novice" Transcendental Meditation Group: This group consisted originally of 38 subjects - 23 males and 15 females - with a mean age of 19,8 years and an age range of from 16 - 28 years. They were volunteers recruited from an audience attending their first introductory lecture on Transcendental Meditation. Psychological tests were administered to these subjects prior to their learning the technique. Six weeks after having learned Transcendental Meditation, 28 subjects who were still practising the technique were re-tested. The statistical analysis was restricted to this reduced group of 28 subjects - 15 males and 13 females - with a mean age of 19,9 years and an age range of from 16 - 28 years. The 10 subjects who were not re-tested were excluded from the study for a variety of reasons (see Appendix H) e.g., for failing to meditate at least 4 times per week, for repeatedly failing to keep "re-test" appointments, as a result of hospitalisation and as a result of being forbidden (by parents) to start meditating.

For analysis purposes, this group of 28 subjects was sub-divided into a "regular" and an "irregular" sub-group on the basis of their meditation regularity. This procedure is described in section 5.6.2.

5.2 Apparatus

5.2.1 Electrophysiological Apparatus: A Beckman Type R Dynograph multi-purpose laboratory recorder equipped to record four channels of information was employed. It included 4 Type 481B Preamplifiers, 2 Type

482 M8 Amplifiers, 3 Type 9806A AC/DC Couplers and one Type 9842 GSR Coupler. In addition, it incorporated a vertical (paper) chart-drive with 8 chart speeds from 0,1 to 25 cm/sec. The writeout medium consisted of ink on prefolded rectilinear paper.

A Beckman Type RP Dynograph table-top recorder equipped to monitor 2 channels of information was also employed. It incorporated 2 Type 481B Preamplifiers, one Type 482 M8 Amplifier, one Type 9806A AC/DC Coupler and one Type 9842 GSR Coupler. The (paper) chart-drive provided 8 chart speeds from 1 to 250 mm/sec. The writeout medium was ink on prefolded rectilinear paper.

The EEG electrodes consisted of silver/silver chloride pad electrodes constructed and supplied by the EEG Department at Groote Schuur Hospital, Cape Town. They were attached to the scalp by means of a system of headstraps. This system was chosen as it permitted the quick application of the electrodes (i.e., about 20 seconds per electrode), it provided nearly artifact-free recordings and because the headstraps (even after 45 minutes) caused no discomfort. The ECG electrodes and the skin resistance electrodes consisted of 2 cm square silver disc electrodes which were attached by means of adjustable rubber straps.

The electrode paste used for the EEG and the ECG recordings was DB electrode paste manufactured by Day-Baldwin, Inc., Hillside, New Jersey, whilst that employed for the skin resistance recordings was a non-abrasive paste prepared by the Department of Bio-Engineering at Groote Schuur Hospital, Cape Town. It consisted of an agar jelly prepared according to the instructions of Wenger and Cullen (in Greenfield and Sternbach, 1972).

A Philips PM 3200 single beam oscilloscope with a frequency range of 0 - 10 M Hz was used.

An EEG Spectrum Analysis Unit with numerical readout was used. This apparatus was specially designed and constructed by electrical engineer Richard Decker of the Department of Electrical Engineering, University of Cape Town. The requirement of the EEG Spectrum Analysis unit was a numerical readout in terms of percentage time occurrence of 4 predetermined

EEG spectrum/

EEG spectrum bands. These were:

Beta	:	12,2 - 22,5 Hz
Alpha	:	8,0 - 12,2 Hz
High (frequency) Alpha:		10,0 - 12,2 Hz
Low (frequency) Alpha :		7,9 - 10,2 Hz

Data pertaining to the validity and stability of the Spectrum Analysis Unit are contained in Appendix M. Briefly, the EEGs of 10 subjects were scored in terms of percentage time occurrence of the above four frequency bands by the unit and (blind) by the visual examination of the EEG paper records. A comparison between the two techniques revealed a correlation of 0,98 for alpha, 0,96 for beta, 0,86 for high alpha and 0,83 for low alpha. The stability or reliability of the instrument was determined by means of periodical checks against a Hewlett-Packard Wave Generator. No adjustments were required during the time that unit was in use.

The core of the unit comprised 4 "Consumer Microcircuits " FX 101 frequency-sensitive switches (i.e., one for each predetermined EEG spectrum band) acting in an in-band mode. The upper and lower frequency limits of the bands were determined by means of external high quality R.C. components. The FX 101 was essentially a M.O.S. (metal oxide silicon) digital filter, the in-band state of which activated an external device that closed a relay. The closure of this relay fed a 1 Hz pulse (supplied by a pulse-generator) to the relevant electro-mechanical counter. The cumulative numerical display thus represented the cumulative time in seconds that a particular EEG frequency band was present in the record. The numerical display included, in addition to the four predetermined spectrum band cumulative time displays, a total time elapsed readout which was continuously fed by the pulse-generator (i.e., it bypassed the FX 101s). (see Figure I).

Two aspects of the circuit details require elaboration. First, the signal recognition time of the FX 101 was approximately 3 cycles of in-band input. By means of an external hysteresis control, the out-band hysteresis time was preset to compensate for this switch-on delay (of about 0,4 seconds in the alpha frequency range). Second, as the FX 101s required a fairly stable baseline, a high-pass filter was included to eliminate this undesirable and unavoidable aspect of the EEG trace.

This/

This filter consisted of a 4-stage unity-gain Butterworth filter (with maximally flat frequency response) with a low frequency attenuation of approximately 48 dB per octave. The high-pass filter was, in addition, buffered at both input and output stages by adjustable high-gain amplifiers (Type 741 Integrated Circuits), thus permitting one to adjust the output voltage amplitude to the FX 101s.

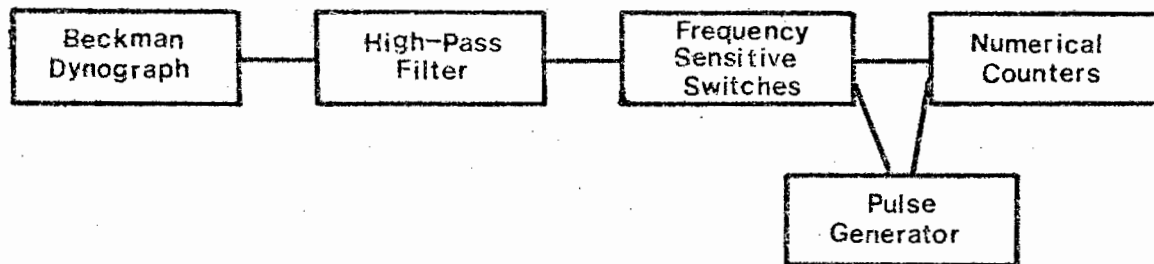


Figure 1. Diagram of the EEG Spectrum Analysis Unit

An auditory feedback apparatus was used to provide feedback for the presence of alpha. Closure of the alpha relay in the EEG spectrum Analysis Unit completed a 12 volt power circuit which activated a 1000 Hz audio-oscillator, the output of which was amplified to drive a loudspeaker. The amplitude of the feedback signal was approximately 50 dB (A) (Stevens, 1956).

5.2.2 Autonomic Balance Apparatus: For a full description of the apparatus employed in the Autonomic Balance determination see section 5.3.2. The apparatus included a dermatographia stimulator (see Figure 2), a stop watch, an apparatus for measuring salivary output similar to that illustrated in Figure 3, a sphygmomanometer and a stethoscope. In addition, a Beckman Type RP Dynograph two-channel recorder incorporating 2 Type 481B Pre-Amplifiers, one Type 482 M8 Amplifier, one Type 9806A AC/DC Coupler and one Type 9842 GSR Coupler was employed to record the ECG (from which heart period was calculated) and palmar and volar skin conductance.

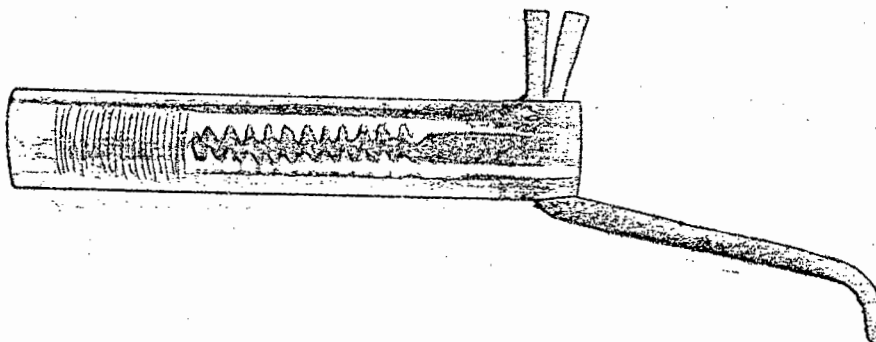


Figure 2. Dermatographic stimulator. The end of the movable stylus is curved and rounded to a tip 2 mm in diameter, and the upright indicator is set at a right angle to the stylus arm. The plastic handle contains a fixed upright indicator and a spring whose tension against the stylus can be varied by a calibration screw. In use the movable indicator is brought parallel to the fixed indicator to deliver the required pressure.

5.2.3/

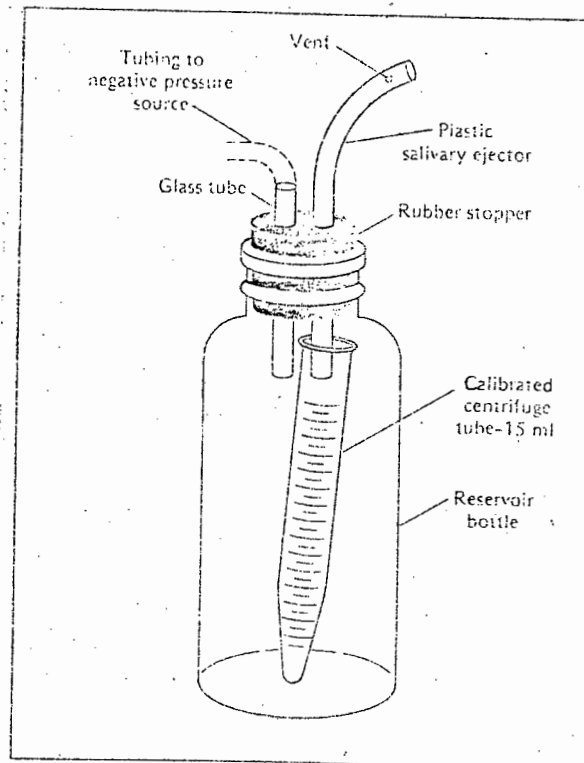


Figure 3. Apparatus for measurement of salivary output. Adapted from M. A. Wenger and M. Ellington, The measurement of autonomic balance in children: Method and normative data. *Psychosomatic Medicine*, 1943, 5, 241-253. By permission of the publishers.

5.2.3 Reaction-Time Apparatus: This instrument was developed and built by Mr Humphris, senior technician of the Department of Psychology at the University of Cape Town, in 1972. Essentially, with this instrument one of 3 possible light stimuli could be presented randomly to a subject whose task it was to move his preferred hand through a distance of 10 cm to extinguish the light (as quickly as possible) by pressing one of 3 coloured buttons corresponding to the illuminated coloured light. The apparatus had the capacity to measure to within one-hundredth of a second the time elapsed between the presentation of a light stimulus and its extinction. This time interval constituted the reaction-time. The apparatus may be seen therefore to have provided a "three-choice discriminative reaction-time task" (Slabier & Dyal, 1963).

5.2.4 Short-Term Memory/Perceptual Speed Apparatus: This apparatus consisted of (1) a Cambridge Tachistoscope, Unity Type CT 2 No. 548 model which was manufactured by Behavioural Research and Development Limited and is obtainable from Day-Baldwin, Inc., Hillside, New Jersey, and (2) four

sets of 5 tachistoscope cards. Each card contained 3 typed nonsense syllables of 40% association value (after Glaze, 1928). In addition, there was one set of three tachistoscope cards which was simply used to familiarise the subjects to the demands of the task.

5.2.5 Psychological Test Apparatus: The Stanford Hypnotic Susceptibility Scale (Weitzenhoffer & Hilgard, 1959) consists of two parallel forms - A and B - which permit subjects to be tested on different occasions on somewhat different test-suggestions with little loss of reliability. Whereas these two forms of the scale tend to stress overt responses to hypnotic suggestions, a form C (Weitzenhoffer & Hilgard, 1962) tends to tap more cognitive aspects of hypnotic susceptibility. Forms A and B are reported by the authors to be strictly comparable with test-retest correlations in the region of 0,83 having been obtained on 124 subjects tested on one form and then tested two days later on the other. The test-retest reliability of the same forms over two days is reported to be as high as 0,91. The basic assumption underlying the Stanford Hypnotic Susceptibility Scale is that a hypnotic trance is necessary for the elicitation of positive responses to the test-suggestions included in the test. A standardised hypnotic induction procedure is thus included, and is, in fact, intertwined with the standardised administration of the test-suggestions. Since the two sets of variables - hypnotic induction procedure and test-suggestions - are intertwined in this way, the instrument is not conducive to studies where the independent assessment of the effects of antecedent variables are to be determined. It is a fairly inflexible test of hypnotic suggestibility and has to be modified in order to assess the effects of waking suggestibility or of hypnotic induction per se. It is nevertheless the most widely used instrument in the field today, employed by investigators of many theoretical persuasions.

The Barber Suggestibility Scale (Barber, 1965a) is constructed so as to permit being preceded by a wide variety of antecedent variables - hypnotic induction procedures, task motivational instructions, placebo instructions, etc. The instrument thus permits the independent manipulation of the many antecedent variables held by adherents of the "alternative non-trance hypnosis paradigm" to influence suggestibility. The scale places equal emphasis on both objective and subjective aspects of suggestibility. The test-retest reliability of the scale administered under a direct suggestions

condition/

condition (as was done in the present study) was examined by Barber and Glass (1962) and by Barber and Calverley (1963). Sixty female college students were tested and retested within one week on their responses to the scale by Barber and Glass (1962) and a product-moment test-retest correlation of 0,88 ($P < .001$) was obtained (for the "objective" scores - "subjective" scores were not recorded). Barber and Calverley (1963) obtained test-retest correlations of 0,82 ($P < .001$) for both the "objective" and the "subjective" scores on 29 student nurses over an interval of 6 weeks. The split-half reliability of the scale administered under a direct suggestions condition has been reported by Barber (1965a) to be in the region of 0,79 for the "objective" scores and 0,84 for the "subjective" scores.

The Taylor Manifest Anxiety Scale (Taylor, 1953) consists of 50 items selected by 5 clinicians from the MMPI to be indicative of "manifest anxiety" supplemented by 175 "buffer items". The normative data on the test, which is presented under the innocuous title of "Biographical Inventory", were obtained on a sample of 229 students of psychology. The mean score was approximately 14. The author reported that the test-retest reliability of the test over 4 weeks on a group of 179 subjects was 0,88. With regard to its validity, Anastasi (1961) wrote that favourable evidence had been obtained from studies that compared neurotic and psychotic patients with normal groups. For example, a group of 103 neurotic patients drawn from both an in- and out-patient population demonstrated a median score of 34 on the MA scale - a score equivalent to the 98,8 percentile of the normalised sample (Taylor, 1953). Correlation studies between scores on this instrument and physiological indicants of arousal have produced inconsistent results. For example, positive correlations between physiological indicants of arousal and MA scores have been obtained by Rappaport and Katkin (1967) and by Kelly, Brown and Shaffer (1970) but negative results have been reported by Katkin and McCubbin (1969), Katkin (1965), Sorason (1960) and Silverman (1957). Katkin (1966) offered a plausible explanation for this reported failure to relate MA scores to physiological indicants of arousal - particularly to GSR responses - as being a function of the fact that whereas physiological indicants of anxiety are indicative of transitory anxiety - that is, anxiety actually present at the time of testing, the MA scale measures a more generalised form of anxiety.

The Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1964)

consists of/

consists of 33 items selected from a number of current personality inventories by 10 judges to meet the criterion of "cultural approval and yet be untrue of virtually all people, and have minimal pathological or abnormal implications." In order to control for "acquiescence", 18 of the items were keyed "true" and 15 "false". Using a standardisation sample of introductory psychology students, the authors obtained a mean of 11,65 for 100 male subjects and a mean of 13,51 for 86 female subjects. The reliability of the scale was also determined by the authors. The test-retest reliability of a sample of 57 subjects over a period of a month was 0,88. Using the Kuder-Richardson formula 20, they also found the internal consistency of the test to be 0,88. Crowne and Marlowe (1964) consider the scale to be an indirect measure of "need for approval". They further contend that people differ with respect to the strength of this need, with high-need persons tending more to engage in culturally sanctioned behaviour and avoiding those that are not. Their formulation appears to account well for the empirical findings with respect to the relationship between the M-C SD Scale scores and scores on other tests. It has generally been found that subjects who score high on the M-C SD Scale achieve lower scores on the MMPI clinical and derived scales (including the Taylor Manifest Anxiety Scale, the correlation being -0,25). They contend that this is simply due to the fact that high M-C SD scale subjects tend more to avoid responses considered undesirable in the present social milieu - including those of admitting to anxiety, frustrations, unhappiness, etc. It must be stressed, however, that the correlations between these clinical dimensions and the M-C SD Scale scores were low to moderate, "indicating that the M-C SD Scale is accounting for some, but not all, of the variance."

The Eysenck Personality Inventory (Eysenck & Eysenck, 1964) is purported by its authors to measure two major dimensions of personality - extraversion and neuroticism. The EPI furthermore exists in two equivalent forms - A and B. The means of the combined forms of the EPI obtained on a normal standardisation sample of 2000 subjects are as follows: approximately 27,5 for the "E" dimension and 9,1 for the "N" dimension. The authors report a test-retest reliability in the region of 0,84 (for "N") and 0,94 (for "E") for the combined forms of the test over a period of a year. The split-half reliability of the combined scales is reported to run from 0,85 to 0,95. The validity of the EPI has been reported to be exceptionally high. Evidence in favour of this conclusion has come from a number of

different sources./.....

different sources. For example, using the method of nominated groups, S.B.G. Eysenck (1962) and Eysenck and Eysenck (1963) have shown that when independent judges are asked to rate subjects in terms of "extraversion" and "introversion", or stability or lability, their ratings correspond predictably with the subjects' EPI scores. Additional validation data has been provided by the authors' finding that many groups categorised as "abnormal", particularly neurotics, have much higher than "normal" N scores.

The Repertory Grid which incorporates 14 psychological dimensions is described in section 5.3.5 (see also Appendix K).

The Phenomenological Repertory Grid, which incorporates 35 dimensions related to subjective experience, is described in section 5.3.5 (see also Appendix K).

5.3 Procedure

5.3.1 Electrophysiological Recording Procedure (including the Feedback Procedure): The alpha feedback group and the "advanced" meditator group underwent electrophysiological testing. The alpha feedback group was tested longitudinally and was consequently subjected to two series of examinations. The first was to establish pre-training rest "baseline" data and the second, after they had had 6 weeks regular alpha feedback training, was to obtain post-training alpha feedback data (see section 5.3.6). The "advanced" meditator group on the other hand, was only examined over the short-term and as a consequence, was only subjected to a single series of electrophysiological tests (see section 5.3.8).

During a subject's first one-hour experimental session, the workings of all the equipment he would encounter during the course of his participation in the study was explained to him. In addition, an attempt was made to allay any apparent fears and misconceptions he may have had concerning the experiment. The subject then underwent a typical electrophysiological recording session (during which EEG, ECG and GSR¹ were monitored) of about 30 minutes duration. The data from this first session - the "adaptation" or "habituation" session - were excluded from the analysis. It served therefore simply to permit subjects to adapt to the experimental situation

prior to/

¹ These GSR data are excluded from the present study.

prior to the determination of experimental data.

The procedure followed for each recording session was much the same. The subject was first allowed a few minutes in which to adapt to the experimental situation (during which time he was administered other non-physiological tests), after which he was directed to the experimental room for the attachment of electrophysiological transducers. He was comfortably seated and the appropriate electrode placement areas were thoroughly cleaned with disposable 70% isopropyl alcohol medical swabs. The silver/silver chloride EEG pad electrodes (which were regularly re-chlorided) were attached by means of the system of headstraps to occipital placements O1 and O2 as outlined by the "Ten Twenty System" (Jasper, 1958). A ground electrode, which was common to all transducers, was placed over the frontal region. The silver disc ECG electrodes were attached by means of adjustable rubber straps to the outer aspect of the upper arms. In view of the fact that only heart-rate estimations were required, electrode placements were not critical so long as the QRS complexes could be clearly discerned.

Both the EEG and the ECG electrodes were attached via electrically-shielded Beckman input leads to Type 9806A AC/DC Couplers of the Beckman Type R four-channel recorder situated in an adjacent sound-attenuated and electrically-shielded recording-room.

For all subjects, the EEG and ECG settings on the Beckman Dynograph were kept constant. The time constant of the Type 9806A AC/DC Couplers were set at 0,3 and the high frequency filters at 3,0. For the EEG recording, the Type 481B Preamplifier setting was at 0,5 millivolts per centimeter whilst the setting for the Type 482 M8 Amplifier was at $\times 0,1$ (i.e., 0,1 $\times$ 0,5 millivolts per centimeter), giving a net resultant amplification of 50 microvolts per cm on the recording paper. For the ECG recordings, the amplification was usually set at one-tenth of that for the EEG. This was accomplished by setting the Type 482 M8 Amplifier at $\times 1,0$ (instead of at $\times 0,1$). The usual gain for the ECG was therefore 5 microvolts per cm on the recording paper.

A continuous record on folded rectilinear paper was made at a paper speed of 1 cm per second for both the EEG and ECG channels. In addition, the 2,8 volt peak-to-peak output of the Beckman Type 482 M8 Amplifier's auxilliary output powered both the Philips PM 3200 single beam oscilloscope

and the/

and the EEG Spectrum Analysis Unit. The oscilloscope provided a second monitor of the continuous EEG activity. As a result of the negligible mass of the electron beam, this monitor had the distinct advantage over the paper record of being a more dynamic and sensitive index of EEG activity. (It was particularly valuable for detecting low voltage interference that was not observable on the paper record.) The EEG Spectrum Analysis Unit automatically reduced the information contained in the EEG trace to numerical form. The cumulative times that each of the 4 pre-determined EEG spectrum bands were present in the EEG record were numerically displayed. This constituted the primary form of EEG data in the present study.

After the subject was appropriately attached to the required transducers and was comfortably seated in the recording-room, the experimenter checked, and if necessary, made adjustments to the monitoring and analysis apparatus. Once it had been established that everything was functioning adequately, the experimenter provided the subject with instructions appropriate to the particular experimental condition and retired to the recording-room. No further verbal communication passed between the experimenter and subject until the termination of the recording condition. The experimenter was able, however, to view the subject by way of a curtained window situated behind the subject's chair. The cessation of any condition was signalled by the experimenter knocking quietly on the door of the experimental-room. After waiting for 3 minutes for the subject to adjust, he entered the room and either provided further instructions for another experimental condition or disconnected the subject as required by the experimental design.

For the alpha feedback subjects, there was an additional requirement. That is, that during their post-training test-sessions, they needed also to be provided with feedback for alpha occurrence. This was accomplished by the Auditory EEG Feedback Apparatus which, on detecting alpha in the EEG, signalled the subject by way of a 50 dB(A) 1000 Hz tone (via a loudspeaker) in the experimental-room. In operant terms, the feedback provided corresponded to a continuous schedule of reinforcement.

During the 6-week alpha feedback training period interspaced between the pre- and post-training series of test-sessions, the subjects were simply attached to the EEG and provided with feedback. Although data were recorded

during this/

during this training period, they are excluded from the present analysis.

Conversion of the "Raw" Physiological Data to Numerical Form

The EEG data were converted to numerical form as follows: A subject's EEG data were determined for each 5-minute period of any recording session. Consequently, 4 EEG data determinations were made across the 20-minute pre-training rest conditions, 2 across the 10-minute pre-experimental rest conditions, 4 across the 20-minute experimental conditions and 2 across the 10-minute post-experimental rest conditions. In addition, however, since a subject was exposed to each of these conditions on 4 separate occasions, for analysis purposes the EEG data for any 5-minute period of any condition comprised the mean of the 4 corresponding time periods (see Appendix A).

For any single 5-minute period, the EEG data were derived from the numerical readout of the EEG Spectrum Analysis Unit. Whenever the "total time elapsed" readout had incremented to 300 seconds, the cumulative time scores on each of the 4 predetermined EEG spectrum band numerical displays were recorded and converted to percentage time occurrence of the particular EEG frequencies. For example, should the beta and alpha cumulative displays have registered 48 and 126 seconds respectively at the end of a 5-minute period, this would have constituted a percentage time beta of 16 and a percentage time alpha of 42. These scores were simply derived by dividing the cumulative time in seconds of a particular EEG spectrum band by the total time elapsed and multiplying by 100. At the end of each 5-minute period, after the EEG data had been determined, the 5 numerical displays were reset to zero.

For the purpose of statistical analysis, the percentage time occurrence of each of the 4 predetermined EEG frequency bands were normalised by being converted to z-scores. This procedure is described in section 5.5.

The heart-rate data were converted to numerical form as follows: A subject's heart-rate data, like his EEG data, were determined for each 5-minute period of any recording session. Consequently, the same number of heart-rate determinations as EEG data determinations were made (see Appendix D). As for the EEG data, the heart-rates were based upon the mean of 4 heart-rate determinations since each subject was exposed to each experimental condition on 4 separate occasions.

For any single 5-minute period, the heart-rate constituted the mean of two one-minute QSR complex counts. The counts were obtained from 2 artifact-free one-minute segments of the Beckman Dynograph paper record.

Procedure for measuring Differential Alpha Control

The subjects in the alpha feedback group underwent a pre-training and a post-training test for differential alpha control. Procedures over the two test-sessions were held constant.

The subject was wired for the monitoring of occipital EEG activity (as described above) and seated comfortably in the experimental-room. He was then provided with the following instructions: "Close your eyes and do not open them again until you are told that the test is finished. The test will be of 8 minutes duration and it will be your task, with the aid of tonal alpha feedback, to attempt to either 'enhance' your alpha - that is, to try to keep the tone 'on' for as much of the time as possible - or to 'suppress' your alpha - that is, to try to keep the tone 'off' for as much of the time as possible. There will be a total of 8 of these 'enhance' and 'suppress' alpha trials, each of one minute duration. The ordering of the 'enhance' and 'suppress' trials will be randomised so that you may, for example, receive two 'suppression' trials consecutively. At the start of each one-minute trial, I will inform you as to the nature of your task for the following 60 seconds by calling either 'enhance' or 'suppress'. After being given an instruction, you will be permitted 10 seconds in which to adapt to the demands of the instruction before any data pertaining to your performance will be recorded. I will now leave you for 3 minutes and during this time you may practise freely at controlling the feedback tone. Thirty seconds before the start of the first trial, I will alert you by calling 'ready'".

The 8 X 1-minute "enhance" and "suppress" alpha trials were presented in a systematically randomised order. Specifically, an ABBA-BAAB design was employed wherein A represented a "suppression" trial and B an "enhance" trial. A subject's performance over the test in terms of percentage time alpha, beta, high alpha and low alpha, was derived from the numerical readouts of the Spectrum Analysis Unit. No data were recorded for the first 10 seconds of any trial (to permit the subject to adjust to the demands of the trial). Therefore, for each of the 8 trials, 50 seconds

of EEG data/

of EEG data were obtained; a total of 200 seconds for the 4 "enhance" alpha trials and 200 seconds for the 4 "suppress" alpha trials. A subject's differential alpha control, over either of the two test-sessions, constituted therefore his percentage time occurrence of alpha over the (200 seconds of) "enhance" alpha trials and the (200 seconds of) "suppress" alpha trials (see Appendix J). The procedure by which subjects were rated with regard to their relative increase in differential alpha control from pre-training to post-training is described in section 5.6.

5.3.2 Procedure for Measuring Autonomic Balance ($\bar{A}$): The autonomic balance scores of the alpha feedback group were derived from physiological tests administered before and after a pre-training rest condition and before and after a post-training experimental (or alpha feedback) condition. For the "advanced" meditator group, similar determinations of autonomic balance were made before and after a rest condition and before and after an experimental (or meditation) condition. Therefore, for all subjects, 4 autonomic balance determinations were made (see Appendix E).

Autonomic Balance, that is, the relative sympathetic/parasympathetic balance, was determined by way of a procedure that was in principle compatible with that of Wenger and Cullen (in Greenfield & Sternbach, 1972). A number of minor procedural modifications were introduced to permit the tests to meet the specific requirements of the present study.

Wenger (1941) defined autonomic balance as follows: "The differential chemical reactivity and the physical antagonism of the adrenergic and cholinergic branches of the autonomic nervous system permit of a situation in which the action of one branch may predominate over that of the other. This predominance, or autonomic balance may be phasic or chronic and may obtain for either the adrenergic or the cholinergic system. Autonomic imbalance, when measured in an unselected population, will be distributed continuously about a central tendency which shall be defined as autonomic balance." Wenger (Wenger & Cullen, in Greenfield & Sternbach, 1972) estimates scores of autonomic balance" or $\bar{A}$ from the weighted scores of a battery of 7 physiological tests. He considers $\bar{A}$ to be more reliable than any of the individual tests from which it was derived. High $\bar{A}$ scores are considered to represent a functional dominance of the parasympathetic branch of the ANS whereas low $\bar{A}$ scores are considered representative of

sympathetic/

sympathetic functional dominance.

A considerable amount of data has accumulated concerning the reliability and validity of Wenger's $\bar{A}$ since he first started working on the phenomenon in the early 1940s (Wenger, 1941 1948, 1949, 1966). Wenger's $\bar{A}$ is derived from the scores on a number of physiological tests and although reliability and validity data are available for all of these contributory measures, space consideration necessitates a limitation here to that pertaining only to $\bar{A}$. Wenger (1966) wrote of $\bar{A}$ that, like other measures of physiological functions, it is subject to high variability and as a consequence its reliability is frequently rather low. Test-retest coefficients have ranged from as low as 0,28 to as high as 0,83 for adults. Wenger (1966) maintains, however, that "if the tests are carefully administered", the reliability of $\bar{A}$ may be considerably enhanced as evidenced by a study which obtained a test-retest coefficient of 0,66 over a period of 3 years with children (Wenger, 1943).

The validity of $\bar{A}$ appears to have received considerable support. For example, it has been shown that such drugs as epinephrine, amphetamine and atrophine lower $\bar{A}$ scores (i.e., result in a relative shift toward sympathetic dominance) whilst such drugs as prostigmine raise $\bar{A}$ scores (Wenger, Clemens, Darsie, Engel, Estess & Sonnenschein, 1960; Wenger, 1949). In addition, research has shown a number of psychiatric disorders to be reliably associated with lowered $\bar{A}$ scores (Wenger, 1948; Holt, 1956; Gunderson, 1956; Sherry, 1959; Wenger, Clemens & Cullen, 1965). Further validation evidence has been provided by a study by Smith and Wenger (1965) into the effects on $\bar{A}$ of the "phasic anxiety" of students confronted with oral examinations. The results indicated that all subjects displayed marked and significantly lower $\bar{A}$ scores on the day of examination than on non-examination control days. These studies represent but a small segment of the wealth of empirical and experimental evidence that supports Wenger's (1966) claim that: "In general, good physical health and psychological adjustment will be associated with higher scores; while a deterioration in psychological adjustment, or some physical disorders, will result in lower scores."

In the present study, the 7 physiological measurements were always obtained at the same time of the day for a particular subject in the sound-attenuated recording-room in which an attempt was made to hold constant the temperature and humidity (at 74°F-76°F and 40%). All of the measurements were taken

during the/

during the winter months (May to July) and only after the subjects had been allowed some time to adjust to the room temperature. Precautions were taken to ensure that they were only tested when they were adequately rested and when they had not indulged in prior physical exercise. Finally, only after the apparatus had been explained and demonstrated to the subjects - that is, after they had adapted themselves to some extent to the experimental situation - were measurements actually made. The tests were administered in the following order: Salivary Output, Red Dermographia Persistence and Pulse Pressure. Finally, Heart Period, Palmar and Volar Skin Conductance and Respiration Period measurements were simultaneously recorded.

Persistence of Red Dermographia: (23) (DP)

The red dermographia response was elicited by the application of 2 firm slow strokes over the left biceps with the stimulator (see Figure 2) calibrated to deliver approximately 250 grams pressure. The rounded tip of the instrument was 2 mm in diameter. The persistence of the red dermographia response was more easily observed when two strokes were made in the form of an X. Each stroke was about 3 inches in length and was timed to require approximately 1 second, the stop-watch being started at the incidence of the first stroke. The persistence time was recorded to the nearest minute at which the location of the crossing was no longer a matter of certainty. The normal range of persistence times in the present study ranged from 1-5 minutes.

Salivary Output: (25) (SO)

Saliva was collected in a calibrated centrifuge tube by means of a negative-pressure pump and apparatus similar to that illustrated in Figure 3. A rubber mouthpiece was attached to the plastic tubing. After the subject was comfortably seated, he was required to hold the bottle and was given the following instructions: "We want to find out how much saliva you have. First swallow all that you have in your mouth now." After swallowing had been observed: "Now put the rubber mouth-piece just inside your lips and bring to the front of your mouth all the saliva you can. It will be sucked out of your mouth into the tube. Work hard and see how much you can produce; don't actually spit into the tube, simply get the saliva ready to spit and let the suction draw it out of your mouth." The stop-

watch was/

watch was started at the first observed salivary flow and after 3 minutes the test was terminated. Approximately 10 minutes were provided for the saliva sample to settle in the centrifuge tube before its volume to the nearest 0.1 cc was recorded.

Pulse Pressure: (80) (PP)

All blood pressure readings - systolic and diastolic - were obtained by means of a sphygmomanometer and a stethoscope. The mean of 3 blood pressure readings from the brachial artery of the right arm taken over a 15-minute period provided the data for this test.

Heart Period: (28) (HP)

Three 1-minute duration ECG samples of the seated subject were recorded. (For the ECG recording procedure, see section 5.3.1). From the ECG paper record samples, heart-rate was determined from which the Heart Period was derived.

Palmar Skin Conductance: (37) (PSC)

A constant 10 μ amp current circuit was employed and the readings to the nearest K Ω were converted to μ mhos. The Beckman Type 9842 GSR Coupler set at 10 μ amps in the constant current mode, in conjunction with the Beckman Type RP two-channel recorder, 2 Type 481B Preamplifiers and a Type 482 M8 Amplifier, were used to provide the circuit described.

The electrodes (2 cm square silver discs) were attached by means of adjustable rubber straps to the centre of the palms of the hands after a thin layer of non-abrasive electrolyte paste had been applied to the skin area in contact with the electrodes. Approximately 3 minutes after the electrode application, 3 measurements at 1-minute intervals were recorded and the mean of the 3 was regarded as the final measure.

It should be pointed out that Wenger (Wenger & Cullen, in Greenfield & Sternbach, 1972) recorded the standing palmar conductance whereas in the present study, the subjects were required to remain seated. This deviation was prompted by at least two important demands specific to the present study - that the other electrophysiological transducers attached to the subject not be disturbed and that the subject himself be as little disturbed

as possible/

as possible.

Volar Skin Conductance: (39) (VSC)

This measurement was obtained in the same manner as for Palmar Skin Conductance with the exception that the electrodes were placed over the volar surfaces of the forearms, approximately 10 cm below the cubital fossa. Once again, the mean of 3 measurements to the nearest $K\Omega$, converted to $\mu mhos$, served as the final measure.

Respiration Period: (57) (RP)

During the time that the electrophysiological measurements were being recorded, the respiration of the subjects over 3 X 1-minute periods was observed and counted. The seated subject was totally unaware that he was being observed through the window of the recording-room. The respiration period was derived from the mean of the 3 respiration rate measures.

In view of the nature of these physiological tests, it was not possible to take measurements during the actual "rest" and "experimental" conditions (as some of the tests had the capacity to interfere seriously with the demands of the conditions). Consequently, for the two groups tested on this battery, the measurements were obtained simply before and after the conditions.

Furthermore, the recording of these measures in the present study was made possible only by the presence of 2 experimenters - one who was primarily concerned with the polygraphic monitoring in the recording-room and another who was more concerned with the administration of tests and the recording of relevant times in the experimental-room. This division of labour permitted the battery of 7 tests to be administered within a 15-minute period. Since each subject's experimental session consisted of only one hour (during which, in addition to the $\bar{A}$ tests, a 20-minute experimental or rest condition, a 5-minute period to attach transducers and a few minutes to allow subjects to adapt to the situation, had also to be completed), it was essential that the tests were quickly and efficiently administered.

Procedure for Calculating Autonomic Balance ($\bar{A}$)

This procedure may be conveniently divided into 4 main stages:

(1) Conversion/

(1) Conversion of the experimental data to numerical values:

The required numerical values for both Dermographia Persistence (in minutes) and for Salivary Output (in cc's) were directly recorded. The Pulse Pressure was obtained by subtracting the systolic from the diastolic readings. The Respiration Period was calculated by dividing the mean number of inspirations per minute (over 3 minutes) into 60 seconds to obtain the Respiration Period in seconds. The Heart Period was derived by dividing the mean number of heart beats per minute (over 3 minutes) into 100 000 to obtain Heart Period in mmins. Finally, for the Palmar and Volar Skin Conductance, the means of 3 measures in resistance units were converted to conductance units (μ mhos).

(2) Calculation of the population means and standard deviations of each of the seven test variables:

Although Wenger's method of analysis was followed in principle, it was deemed unjustifiable in the present study to use the means and standard deviations derived from his normative sample for the following reasons:

- (i) There was a number of minor procedural differences between the present study and those of Wenger (Wenger & Cullen, in Greenfield & Sternbach, 1972) on a number of the tests.
- (ii) There was undoubtedly important differences between the populations. Wenger's (1948) normative sample consisted of 488 male military personnel - a group already highly preselected in terms of physical fitness. No such standard was required for the male and female subjects in the present study.
- (iii) Differences in terms of altitude, temperature, etc. between Wenger's studies conducted in Ohio, U.S.A. and those of the present study conducted at Cape Town, South Africa. Wenger (1972) has demonstrated the importance of seasonal and environmental factors in influencing autonomic balance.

A decision was therefore made to derive population means and standard deviations from the present study's experimental subjects (plus from 4 subjects who participated in a related study). The post-rest condition data of 34 subjects, that is, after they had rested for 20

minutes/

minutes, was selected. This ensured that the population means and standard deviations were derived from subjects who had not only rested under the same environmental conditions but also from subjects who were familiar with the testing procedure (having been previously exposed to the pre-rest condition testing).

In this manner, a normalised sample was constructed (for the test variable at resting levels) against which each individual's score could be compared (see Table 1 for the Normative Data - population means and standard deviations).

TABLE 1
Means and Standard Deviations for the Test Variables
calculated from the present Experimental Population

Test Variable	Mean	SD
DP (min)	3.497	6.595
SO (cc)	3.109	1.732
HP (mmHg)	141.282	15.003
PC (μ mho)	17.991	12.361
VC (μ mho)	7.429	10.327
RP (sec)	4.159	0.936
PP (mm Hg)	35.868	9.346

(3) Conversion of the raw numerical data of each subject to T-Scores:

To obtain the T-Scores (or Standard scores) the following formula was used:

$$Z = \frac{X - \bar{X}}{SD}$$

Where X = an individual subject's score on a test variable

$\bar{X}$ = the population mean for that test variable, and

SD = the population standard deviation for that test variable.

In order to eliminate minus signs and decimal points, each z-score was multiplied by 10 and added to 50. Each distribution (T-Scores) then had a mean of 50 and a standard deviation of 10 (Wenger & Cullen, in Greenfield & Sternbach, 1972).

Wenger considers T-Scores which fall below the mean (of 50) to be indicative of relative sympathetic dominance and T-Scores which fall above the mean to be indicative of relative parasympathetic dominance

(see Table 2)/

(see Table 2). Therefore, for test variables SO, DP, PP, HP and RP, the following formula was used to calculate T-Scores:

$$Z^1 = X^1 + Z.SD^1$$

However, for the test variables PSC and VSC, this formula was used:

$$Z^1 = X^1 - Z.SD^1$$

Reference to Table 2 clarifies why these two slightly different formulae were employed for different test variables. For example, whereas a long DP or a high PP are indicative of relative parasympathetic dominance and hence of a T-Score above 50, a high PSC or VSC is indicative of relative sympathetic dominance and hence of a T-Score lower than 50.

TABLE 2

Relationship between Raw Numerical Data and T-Scores

TEST	SYMPATHETIC	PARASYMPATHETIC
Dermographia persistence	Short	Long
Salivary output	Low	High
Heart period	Short	Long
Palmar conductance	High	Low
Volar conductance	High	Low
Respiration period	Short	Long
Pulse pressure	Low	High

(4) Calculation of $\bar{A}$ using Wenger's regression equation:

$$\bar{A} = ,1(T23) + ,2(T25) + ,4(T28) + ,3(T37) + ,1(T39) + ,1(T57) + ,2(T80)$$

where $\bar{A}$ is the estimate score for "autonomic factor" and the T following each beta weight represents the T-Score for the physiological test designated by the subscripts:

T23 = DP, T25 = SO, T28 = HP, T37 = PSC, T39 = VSC, T57 = RP & T80 = PP

Should a subject achieve mean scores on each of the 7 physiological tests, he would obtain 7 T-Scores of 50 and thus a mean score for $\bar{A}$ of 70. According to Wenger (Wenger & Cullen, in Greenfield & Sternbach, 1972), the standard deviation of $\bar{A}$ is 7, and since he views the autonomic balance distribution to approach the normal curve, he contends that approximately 68% of the population demonstrate an autonomic balance score of 70 ± 7 . "Of those individuals who have scores higher than 77, it may be said that they demonstrate an

apparent/

apparent functional dominance of the parasympathetic system. Likewise, those scores below 63 may be regarded as an apparent dominance of sympathetic function. It should be noted that such scores indicate nothing concerning the cause of the deviations. A high score might result from weak sympathetic function, strong parasympathetic function, or both. A low score might indicate a hypoactive parasympathetic system, a hyperactive sympathetic system, or both. All that can be said from this test battery is that a high score is indicative of apparent dominance of parasympathetic function and a low score suggests apparent dominance of sympathetic function."

5.3.3 Reaction-Time Procedure: The alpha feedback group and the "advanced" meditation group were tested on a three-choice discriminative reaction-time task before and after their participation in a 20-minute rest condition and before and after their participation in a 20-minute experimental condition (during which time the groups practised their respective techniques). In order to control for positional effects, the pre- and post-condition test-sessions were systematically randomised for each experimental group. For example, whilst 10 of the 20 alpha feedback subjects received their pre-experimental condition reaction-time tests before their post-experimental condition tests, the other 10 subjects received their post-experimental condition tests first. (The pre-experimental condition reaction-time tests of these latter subjects were given the following day). This strategy controlled for the possibility of obtained differences between pre- and post-condition scores being simply a function of increased skill.

The procedure for each of the 4 reaction-time test-sessions that a subject underwent was held constant. The subject was seated comfortably in front of the reaction-time apparatus with his preferred hand on the table approximately 10 cm from the three coloured buttons of the apparatus (see section 5.2.3). He was given 5 practice trials with the instruction that he attempt to strike as quickly as possible the button corresponding to the colour of the illuminated light. Approximately 3 seconds before a light was illuminated, the subject was alerted to the impending trial by the experimenter saying, "ready". The 5 practice trials were followed by 10 experimental

trials/

trials. The Experimenter recorded the duration of time to within a 100th of a second taken by the subject to respond to the randomly presented light stimuli with the appropriate button press (which both extinguished the light and stopped a stop-clock). The clock was started at the illumination of the light and stopped at its extinction. The mean response-time of a subject over the 10 experimental trials constituted his reaction-time score for that particular condition (see Appendix F). The statistical analysis in the present study has been limited, however, to an investigation of the pre- and post-experimental condition data. The pre- and post-rest condition data were excluded from the analysis.

5.3.4 Short-Term Memory/Perceptual Speed Procedure: The alpha feedback group and the "advanced" meditator group were tested on the short-term memory/perceptual speed task before and after a 20-minute rest condition and again before and after a 20-minute experimental condition. As for the reaction-time procedure (see section 5.3.3), the ordering of the pre- and post-condition tests was systematically randomised. In addition, the 4 sets of 5 nonsense syllables were systematically randomised. For example, 5 of the 10 "advanced" meditators received list A before the rest condition and list B afterwards whilst the other 5 subjects received list B before their rest condition and list A afterwards. This control served to avoid the admittedly slight possibility of the lists of standardised nonsense syllables not being equivalent in the present context and consequently contributing toward obtained differences between test-sessions.

The procedure for each of the 4 short-term memory/perceptual speed test-sessions that a subject underwent was held constant. He was seated comfortably in front of the Cambridge Tachistoscope and given 3 non-experimental trials using a set of 3 non-experimental syllable cards in order that he might become familiarised to the demands of the task. The task required that he spell as quickly as possible the 3 nonsense syllables contained on a card "flashed" by the tachistoscope. The flash duration of each card started at 0.2 seconds and was incremented by 0.1 second every 2 trials. To successfully meet the task requirement, he was expected to repeat all 9 letters after a particular flash. (i.e., he was not permitted to spell 2 syllables after one flash and the third after another flash). A subject's score on any of the 5 cards presented over a test-session consisted of the number of flashes required for him to satisfy the task requirement. The

mean/

mean number of flashes over the 5 experimental trials constituted his short-term memory/perceptual speed score for that particular test-session (see Appendix G). As in the case of the reaction-time data, the statistical analysis was limited to the pre- and post-experimental condition data. The pre- and post-rest condition data were not analysed.

5.3.5 Procedure for the Administration and Scoring of the Repertory Grids:

Two repertory grids were employed in the present study - the Repertory Grid and the Phenomenological Repertory Grid (see Appendix K). The Repertory Grid was administered to both the alpha feedback and the "novice" meditator groups before and again 6 weeks after they had learned their respective techniques. Their scores over these 2 test-sessions constituted their pre- and post-training scores on the 14 repertory grid constructs. The Phenomenological Repertory Grid on the other hand was administered only once to the alpha feedback (i.e., post-training) and "advanced" meditator groups. Since these instruments were both of a pencil-and-paper nature, they were simply administered to the subjects at the specified times with the request that they complete them at home within a stated time period.

Both of the repertory grids to be described here were constructed according to Bannister's (Bannister & Mair, 1968) modification of Kelly's (1955) original technique. That is, they were constructed so as to permit subjects to rank-order elements against supplied constructs. This modification, as opposed to that where the constructs are elicited individually from each subject, permitted the grids to be used in comparing groups of individuals and in comparing the same group at different times. These were, of course, central requirements in the present study. Slater's (1969) point is accepted, however, that attempts to modify grids for nomothetic use by choosing elements or constructs, or both, for their general acceptability instead of their personal relevance, "... tends to diminish their idiographic sensitivity ..."

The Repertory Grid comprised 15 assigned constructs against which 8 elements were rank-ordered (see Appendix K). The constructs were derived on the basis of a unanimous selection of 3 judges (all psychologists with experience at Transcendental Meditation) from a list of about 50 constructs obtained from a number of psychological publications. The judges were separately asked to select those constructs that they hypothesized would most reflect change as a function of Transcendental Meditation. Thirteen

constructs/

constructs were unanimously selected and added to the constructs "most like I am/least like I am" and "most like I would like to be/least like I would like to be". This method of selecting constructs was resorted to since, at the time of test construction (i.e., early 1972), no data pertaining to the psychological effects of Transcendental Meditation had yet been published. The 34 constructs of the Phenomenological Repertory Grid were derived on the basis of the experimenter's hypotheses concerning phenomena that might be experienced by subjects practising Transcendental Meditation and alpha feedback. Once again, these constructs were added to the constructs, "most like I am/least like I am" and "most like I would like to be/least like I would like to be" and had 8 elements rank-ordered against them (see Appendix K).

The 8 elements of both repertory grids were elicited, following Kelly (1955), from each subject and comprised persons presumed to play an important role in the life histories of the subjects (see "Role Title List" - Appendix K).

After the 8 elements had been rank-ordered against each of the constructs, one had a grid with the following essential properties: "... notably that the variation it recorded was due to construct/element interactions; that it defined by column a dispersion of constructs in element space, and by row a dispersion of elements in construct space; ... In terms of these properties a systematic, exhaustive analysis could be made of the grid" (Slater, 1969).

In the present study, the following technique of scoring the repertory grids was employed. Firstly, the subject's rank-ordering of elements against constructs was re-recorded so that the elements were listed down the side and the constructs along the top. The rank position of each element on each construct was entered into the body of the Table. For example, the following rank-ordering of elements:

(1) TENSE .5. .6. .4. .3. .8. .7. .2. .1. RELAXED

would be re-ordered to give (where construct 1 is "Tense/Relaxed"):

CONSTRUCTS /

CONSTRUCTS		1	2	3	4	5	6	....
ELEMENTS	1	8			5			
	2	7			1			
	3	4			2			
	4	3			4			
	5	1			8			
	6	2			7			
	7	6			6			
	8	5			3			

It may thus be seen that element 5 is ranked first against construct 1.

Secondly, the rank-order correlation of each column with the column representing the construct "most like I am/least like I am" was calculated. That is, the score was obtained by the relationship between the ordering of elements against each of the constructs and the ordering of elements against the construct "most like I am/least like I am". If, for example, construct 4 represented this construct - the central construct - the rank-order correlation of the elements of construct 1 against the elements of construct 4 would yield a difference squared of 128 and hence a rho of -0,52.

This negative correlation between construct 1 (Tense/Relaxed) and construct 4 (Most like I am/Least like I am) is indicative of the subject construing himself as a relatively relaxed person. Were the correlation strongly positive, it would have indicated that the subject construed himself to be relatively tense. One could therefore, on the basis of this relationship between the constructs and the central construct, determine how a subject construed himself with respect to the given construct dimensions.

For the purpose of statistical analysis, the rank-order coefficients representing the relationship between the central construct and the other 14 constructs were not treated as correlation coefficients. They were treated simply as a subject's score on that particular construct dimension. For the Repertory Grid Test, therefore, each subject obtained pre-training and post-training scores on the 14 constructs (see Appendix I).

The 35 rank-order correlations between the constructs of the Phenomenological Repertory Grid and its central construct were similarly not treated as correlation coefficients in the statistical analysis. They were treated simply as a subject's test score on that particular construct. The scores of the alpha feedback and the "advanced" meditator groups on these constructs are presented in Appendix I.

Some comment concerning the reliability of the repertory grid test when employed as was done in the present study is in order. Caine and Smail (1969) obtained a test-retest correlation of 0.58 ($P < .01$) over a period of 3 months with a group of 22 subjects given repertory grid tests with supplied constructs.

5.3.6 Procedure for the Alpha Feedback Group: The alpha feedback subjects were tested in 2 groups - the first having consisted of 10 subjects and the second of 11 (one of whom withdrew as a result of hospitalisation) - over consecutive periods of approximately 7 weeks each. In view of the fact, however, that the individually tested subjects were subjected to identical experimental procedures, they will be treated here as one group. Each subject was individually tested at the same time of the day for each of their daily hour-long sessions over their 7-week participation in the study. All testing was undertaken between the hours of 9 a.m. and 8 p.m.

Unlike the "advanced" meditator group which underwent only short-term testing (see section 5.3.8), the alpha feedback group was also examined over the long-term. This longitudinal study incorporated short-term experimental design aspects, however, that corresponded to that of the "advanced" meditator group. The alpha feedback and "advanced" meditator groups could thus be compared over the short-term (with respect to their physiological and behavioural correlates). The longitudinal experimental design of the alpha feedback group corresponded to that of the "novice" Transcendental Meditation group (see section 5.3.7). This permitted a valid comparison between the two groups over the long-term (with respect to psychological correlates).

The alpha feedback study may be conveniently divided longitudinally into three stages (see Figure 4). The first stage comprised a period of 5 days

(and/

subject was subjected to the same recording procedure. The means of the electrophysiological measurements (i.e., occipital EEG data and heart-rate) obtained over these 4 sessions constituted the pre-training rest condition data of the alpha feedback group (see Appendices A & D).

The third session of the pre-training period was directed toward the determination of pre- and post-rest condition autonomic balance measures. Consequently, the 7 contributory (toward $\bar{A}$) physiological tests were administered during a 15-minute test-session prior to the 20-minute rest condition (which was conducted as above) and again during a 15-minute test-session thereafter. Care was taken to ensure that the post-rest condition testing did not arouse the subject. It should be noted that the post-rest condition autonomic balance measurements contributed toward the normalisation data of the present study (see section 5.3.2). The data obtained over this test-session constituted the pre- and post-rest condition autonomic balance measures of the alpha feedback group (see Appendix E).

Pre- and post-rest condition scores on short-term memory/perceptual speed and on reaction-time (in this order) were determined over sessions 4 and 5. The requirement that the order of presentation of the pre- and post-rest condition tests be systematically randomised (for both tests) was met by giving half of the subjects their pre-rest condition tests on the 4th day. The other half of the subjects received their post-rest condition tests on the 4th day before their pre-rest condition tests on the 5th day. These data constituted therefore the pre- and post-rest condition scores on short-term memory/perceptual speed and on reaction-time for the alpha feedback group (see Appendices G & F respectively).

On completion of the 5th session, the subject was tested for differential alpha control. This was the subject's first exposure to the feedback apparatus and the data obtained represented his pre-training differential alpha control score (see Appendix J).

During the course of these 5 days, the following psychological instruments were administered to the subjects: the Barber Suggestibility Scale, the Stanford Hypnotic Susceptibility Scale, the Marlowe-Crowne Social Desirability Scale, the Taylor Manifest Anxiety Scale, the

EPI and the Repertory Grid. The BSS and SHSS were administered orally by experimenter and scored immediately. Since the remainder of the tests were of a pencil-and-paper nature and contained standardised printed instructions, they were simply administered to the subjects with the request that they complete them at home prior to the end of the pre-training period. The subjects' scores on these psychological instruments constituted their pre-training psychological test data (see Appendix H).

(2) Five-week Alpha Feedback Training Period:

A subject was requested to attend at least 5 feedback practice sessions per week. During each session, he was expected to practise the task of alpha enhancement for from 30 - 50 minutes.

The subject was wired only for the monitoring and recording of occipital EEG data and received toral feedback for the presence of alpha. In addition, at the end of each session, the experimenter provided him with verbal feedback concerning the percentage time alpha that he had produced during the session. This information was obtained from the numerical displays of the EEG Spectrum Analysis Unit.

(3) Post-Training Period:

The post-alpha feedback training data were obtained over 6 sessions. Essentially the same recording procedure as for the pre-training period was followed but with 2 important additions.

First, instead of consisting simply of a 20-minute rest condition, these sessions incorporated recording over a 10-minute (eyes-closed) pre-experimental rest condition, a 20-minute experimental (or alpha feedback) condition and a 10-minute (eyes-closed) post-experimental rest condition. And second, alpha feedback was provided during the experimental conditions.

Sessions 3, 4, 5 and 6 included electrophysiological monitoring and recording over a 10-minute (eyes-closed) pre-experimental rest condition, a 20-minute experimental (or alpha feedback) condition and a 10-minute (eyes-closed) post-experimental rest condition. For these sessions the subject was seated comfortably in the experimental-room and wired for the monitoring and recording of occipital EEGs, heart-rate and GSRs.

The subject, for the pre-experimental rest condition, was instructed to simply sit quietly and to relax until he received a signal (in the form of a soft knock on the interleading door) to start enhancing his alpha by means of tonal feedback (which was then provided). The end of the 20-minute alpha feedback (or experimental) condition was again communicated in the same manner (and the feedback was terminated) and he was instructed to simply rest and relax once more with his eyes closed until signalled that the recording session had ended. Three minutes were allowed between the signal that indicated a change in condition and the actual recording of data (to permit him to re-adjust to the demands of the new condition). The means of the electro-physiological measurements (i.e., occipital EEG data and heart-rate) obtained over these 4 sessions constituted the pre-experimental rest condition, the experimental condition and the post-experimental rest condition data of the alpha feedback group (see Appendices A & D).

The first post-training experimental session was directed toward the determination of pre- and post-experimental condition autonomic balance measures. Consequently, the 7 physiological tests were administered during a 15-minute test-session prior to the 20-minute experimental condition (which was conducted as above but without the pre- and post-experimental rest conditions) and again during a 15-minute test-session thereafter. Care was taken to ensure that the post-experimental testing did not arouse the subject. These data constituted, therefore, the pre- and post-experimental condition autonomic balance measures of the alpha feedback group (see Appendix E).

The pre- and post-experimental condition scores on short-term memory/perceptual speed and on reaction-time (in this order) were determined over sessions 2 and 3. During session 2, the subject underwent only a 20-minute experimental condition. That is, there were no pre- and post-experimental rest conditions. The requirement that the order of presentation of the pre- and post-experimental condition tests be systematically randomised (for both tests) was met by giving half of the subjects their pre-experimental condition tests before their post-experimental condition tests on day 2. The remaining subjects received their post-experimental condition tests on the 2nd day before

receiving/

receiving their pre-experimental condition tests on the 3rd day. These data constituted, therefore, the pre- and post-experimental condition scores on short-term memory/perceptual speed and on reaction-time for the alpha feedback group (see Appendices G & F).

On completion of the 6th (and final) session, the subject was tested for differential alpha control. Feedback was provided during the test and the data obtained constituted the subject's post-training differential alpha control score (see Appendix J).

During the course of these 6 days, the subjects were re-tested on the psychological instruments they were given prior to training. The same procedure was followed and their scores constituted their post-training psychological test data (see Appendix H). The Phenomenological Repertory Grid was also administered (see Appendix I).

5.3.7 Procedure for the "Novice" Transcendental Meditation Group: This group participated in a longitudinal psychological study into the effects of regular Transcendental Meditation practice. In terms of experimental design, this study is directly comparable to the longitudinal psychological component of the alpha feedback experiment (see section 5.3.6). Both groups were tested on the same battery of psychological tests before and after their exposure to 6 weeks' regular practise of their respective techniques.

Thirty-eight subjects who had indicated their intention to learn Transcendental Meditation were individually tested on the following battery of psychological tests in the week prior to their initiation into the practice: the Barber Suggestibility Scale, the Marlowe-Crowne Social Desirability Scale, the Taylor Manifest Anxiety Scale, the EPI and the Repertory Grid. The Barber Suggestibility Scale was administered orally and scored immediately. In view of the remainder of the tests being of a paper-and-pencil nature with standardised printed instructions, they were simply administered to the subjects with the request that they complete them at home and return them before they were initiated. The subjects's scores on this first testing constituted their pre-training psychological test scores (see Appendix H).

They were then taught the technique of Transcendental Meditation (by teachers

at the/

at the Cape Town Transcendental Meditation Centre) and attended the required follow-up lectures. Six weeks after having learned meditation they were again contacted and those who reported a meditation regularity of 4 or more times a week were re-tested on the above psychological tests (except for the EPI where the alternative form was given. The administration of the 2 forms were counterbalanced across the pre- and post-training test-sessions). In addition, the regularity of meditation of all subjects was established (see Appendix H). Their scores on this second testing constituted the post-training psychological test scores of the "novice" meditator group (see Appendix H).

5.3.8 Procedure for the "Advanced" Transcendental Meditation Group: The subjects in this group participated in a short-term experiment that included both physiological and behavioural testing over 9 one-hour sessions. Each subject was individually tested at the same time of the day for each of the sessions. All testing was undertaken between the hours of 9 a.m. and 8 p.m. In terms of experimental design, the electrophysiological test-sessions of this group correspond to the post-training experimental sessions of the alpha feedback group.

The first test-session of each subject served to permit him to adapt or habituate to the unfamiliar experimental situation. Since the procedure for this "adaptation" session was identical to that of the alpha feedback group (see section 5.3.6), it shall not be repeated here.

The second and third test-sessions, like the first, were concerned with rest condition data.

The second session was devoted to the determination of pre- and post-rest condition autonomic balance measures. Consequently, the 7 physiological tests were administered during a 15-minute test-session prior to the 20-minute rest condition (which was conducted as above) and again during a 15-minute test-session thereafter. Care was taken to ensure that the post-rest condition testing did not arouse the subject. It should be noted that the post-rest condition autonomic balance measurements contributed toward the normalisation data of the present study (see section 5.3.2). The data obtained over this test-session constituted the pre- and post-rest condition autonomic balance measures of the "advanced" meditator group (see

Appendix E).

The pre- and post-rest condition scores on short-term memory/perceptual speed and on reaction-time (in this order) were determined over sessions 3 and 4. The third session included another 20-minute rest condition. The requirement that the order of presentation of the pre- and post-rest condition tests be systematically randomised (for both tests) was met by giving half of the subjects their pre-rest condition tests before their post-rest condition tests on the 3rd day. The other half received the post-rest condition tests on the 3rd day before the pre-rest condition tests on the 4th day. These data constituted the pre- and post-rest condition scores on short-term memory/perceptual speed and on reaction-time for the "advanced" meditator group (see Appendices G & F respectively).

Sessions 4, 5, 7 and 9 included electrophysiological monitoring and recording over a 10-minute (eyes-closed) pre-experimental rest condition, a 20-minute experimental (or meditation) condition and a 10-minute (eyes-closed) post-experimental rest condition. For these sessions, the subject was seated comfortably in the experimental-room and wired for occipital EEG, heart-rate and GSR measurement. The subject, for the pre-experimental rest condition, was instructed to simply sit quietly and to relax with his eyes closed until he received a signal (in the form of a soft knock on the interleading door) to start meditating. The end of the 20-minute meditation condition was again communicated in the same manner and he was instructed to stop meditating and to simply rest and relax once more with his eyes closed until the experimenter signalled the end of the recording session. Three minutes were allowed between the signal that indicated a change in condition and the actual recording of data (to permit the subject to adjust to the demands of the new condition). The means of the measurements (i.e., occipital EEG data and heart-rate) obtained over these 4 sessions constituted the pre-experimental rest condition, the experimental condition and the post-experimental rest condition electrophysiological data of the "advanced" meditator group (see Appendices A & D).

Session 6 was directed toward the determination of pre- and post-experimental condition autonomic balance measures. Consequently, the 7 physiological tests were administered during a 15-minute test-session prior to the 20-minute experimental condition (which was conducted as above but without

the pre- and post-experimental rest conditions) and again during a 15-minute test-session thereafter. Care was taken to ensure that the post-experimental testing did not arouse the subject. These data constituted the pre- and post-experimental condition autonomic balance measures of the "advanced" meditator group (see Appendix E).

The pre- and post-experimental condition scores on short-term memory/perceptual speed and on reaction-time (in this order) were determined over sessions 8 and 9. During these two sessions, the subject was monitored over only the 20-minute experimental condition. That is, the pre- and post-experimental rest conditions were excluded. The requirement that the order of presentation of the pre- and post-experimental condition tests be systematically randomised (for both tests) was met by giving half of the subjects their pre-experimental condition tests before their post-experimental condition tests on day 8. The other half received the post-experimental condition tests on the 8th day before receiving the pre-experimental condition tests on the 9th day. These data constituted the pre- and post-experimental condition scores on short-term memory/perceptual speed and on reaction-time for the "advanced" meditator group (see Appendices G & F).

5.4 Statistical Analysis Employed

The statistical analysis of the data was carried out in accordance with the principles outlined in Roscoe (1969), Winer (1962) and Kirk (1968). Correlation matrices were calculated by the Pearson Product-Moment formula, as given in Roscoe (1969, p. 71).

Certain of the experimental designs involved the comparison of 2 groups on "before" and "after" measures (or in some cases, on "before", "during" and "after" measures) on a given variable. Since these are thus two factor designs where the subjects are measured repeatedly, the appropriate statistical analyses are two-way analyses of variance with repeated measures on one factor (Winer's 1962 terminology). (In terms of Kirk's 1968, p. 248 terminology, this corresponds to two-way split-plot analyses of variance.)

Where the variance analyses indicated significant effects, whether main or interaction, simple main effects were carried out. These were essential, of course, in the case of significant interaction effects but were employed as a follow up to significant main effects before comparisons between means were

undertaken/

undertaken in order to isolate those levels of the factors where such comparisons would prove fruitful. The simple main effects were carried out as described in Kirk (1968, p. 263). Finally, significance in the simple main effects analyses were examined by comparison between cell means. These comparisons were carried out using the Tukey HSD procedure, as outlined in Kirk (1968, p. 292). It must be noted that the Tukey HSD statistics reported in the results section should be referred to tables of the Studentised Range Statistic for significance.

To evaluate the differences between two groups simultaneously on more than one variable, Hotelling's T-Square was employed (Winer, 1962, section 1.13). In order to determine the relative importance of various measures in distinguishing between two groups, Stepwise Multiple Linear Regressions were employed (Darlington, 1968).

The conventions that are used to indicate the level of significance of the various statistics in the following sections are as follows:

* $P < .05$

** $P < .01$

5.5 Transformation of the EEG Data to Normalised Form

It was decided to normalise the EEG data in order that each subject's EEG data should receive more equal statistical weight. Vassiliadis' (1972) adoption of a similar strategy was similarly motivated (see section 3.1.1). In view of the enormous variability shown by subjects in terms of percentage time occurrence of specific EEG frequency bands, ranging from 0% to 100%, "absolute EEG data" and "relative EEG changes" afford many subjects disproportionate weight in statistical analyses. For example, should two subjects S_1 and S_2 have pre-training alpha levels of 4% and 40% respectively, and post-training alpha levels of 10% and 60% respectively, it must be clear that S_2 is going to exert a far stronger influence in statistical analyses that employ "absolute EEG data". The fact that S_2 's relative alpha increase (50%) is less than that of S_1 (150%), raises doubt concerning the validity of statistical analyses directed toward "absolute EEG data". The application of statistics to "relative EEG changes" rather than to the "absolute EEG data" is also a questionable strategy. For example, should a subject who increases from 1% to 2% alpha be afforded the same statistical weight as another who increases from 40% to 80% (since both increase by 100% in rela-

tive terms)?/

tive terms)? The transformation of the absolute EEG data of each subject to normalised form achieves to a large degree a more equal weighting of the EEG data of individual subjects in the statistical analysis.

All the EEG data in the present study were transformed from percentage time occurrence of specific EEG frequency bands (see Appendix A) to percentage time occurrence of these EEG frequency bands in z-scores. For the longitudinal examination of the alpha feedback group, the base for the calculation was the 20-minute pre-training rest conditions (see Appendix C), whilst for the short-term examinations and comparison of the alpha feedback group and the "advanced" meditator group, the base for the calculation was the 10-minute pre-experimental rest conditions (see Appendix B). For the longitudinal transformations, there were 4 pre-training rest condition values (corresponding to each 5-minute period of the 20-minute condition), each of these being the mean of 4 experimental sessions (see section 5.3.1). The mean and standard deviations used for the z-scores were based on these 4 values. For the short-term transformations, there were 2 pre-experimental rest condition values (corresponding to each 5-minute period of the 10-minute condition), each of these being the mean of 4 experimental sessions (see section 5.3.1). The means and standard deviations used for the z-scores were based on these 2 values. Given this mean ($\bar{X}$) and standard deviation (SD) for each subject on each variable, the subsequent data for a given subject (X_1) was transformed as follows for each variable (i.e., for each of the 4 pre-determined EEG spectrum bands):

$$Z_1 = \frac{X_1 - \bar{X}}{SD}$$

In some cases, the standard deviation computed on the 4 values (for the longitudinal transformations) or on the 2 values (for the short-term transformations) was "obviously" too small; for example, the values may have been equal, leading to a "false" SD = 0. In these instances, the standard deviation was altered to a minimum value of 0.35. This procedure was followed in order to avoid excessively large z-scores and was thus a conservative procedure in the sense that the object was to minimise the occurrence of a type 1 error in the statistical analyses (Kirk, 1968, p.31).

5.6 The Within-Subjects Division of the Alpha Feedback and "Novice" Meditator Groups

5.6.1 The Alpha Feedback Group: The alpha feedback experiment incorporated not only within-subjects design aspects - permitting each subject to act as a self-control - but also between-subjects design aspects. The between-subjects control procedure involved the subdivision of the alpha feedback group into a "successful" and an "unsuccessful" sub-group, thus providing groups that differed with respect to their loading on the crucial independent variable - level of "success" at feedback-associated alpha enhancement. This section is concerned with (1) the reasons for the selection of this particular form of between-subjects control procedure; and (2) the reasons for the selection of the present criterion of "success" at feedback-associated alpha enhancement.

The present between-subjects control procedure was adopted in preference to that of comparing of the alpha feedback group with a non-alpha feedback group - whether simply a non-reinforced control group or a yoked control group. This decision was prompted by the desire to avoid the following problems associated with these alternatives.

- (1) It confounds the influence of feedback-associated alpha enhancement with that of all the other variables in the alpha feedback situation. Any differences found could thus simply be attributed to the gross introduction of alpha feedback training to the experimental but not to the control group. (This criterion is, of course, not applicable should a yoked control group be employed.)
- (2) There are serious practical problems involved in matching the experimental and control groups. They would have to be equated, for example, with respect to their predisposition toward undergoing alpha feedback training.
- (3) An ethical problem arises when one uses a subject as a yoked control (i.e., he has to be deceived) over an experiment of such long duration.

The criterion of "success" at feedback-associated alpha enhancement used throughout this study was selected from the following six alternative criteria:

1. The absolute change in percentage time alpha shown by a subject from the pre-training rest conditions to the post-training experimental (or feedback) conditions.
2. The relative change in percentage time alpha shown by a subject from the pre-training rest conditions to the post-training experimental conditions.
3. The absolute percentage time alpha change shown by a subject from the pre-

training/

- training rest conditions to the post-training experimental conditions divided by the subject's post-training experimental condition percentage time alpha levels.
4. The percentage time alpha in z-scores change shown by a subject from the pre-training rest conditions to the post-training experimental conditions.
 5. The relative "strength" of the subjective phenomenal concomitants of alpha feedback training as reported by the subject and rated by the experimenter.
 6. The relative change in differential alpha control shown by a subject from a pre-training to a post-training test-session.

The methods for scoring the 20 alpha feedback subjects with respect to the first 3 criteria of "success" are self-explanatory. For all 3 criteria, they were assigned a rating of from 1 to 4 (with 5 subjects per rating) on the basis of the magnitude of their scores. Lower ratings corresponded to higher positive scores. Thus, for example, a subject who showed a very large increase in absolute alpha abundance would be assigned a low rating. The ratings of the 20 subjects according to these criteria are shown in Table 4.

The rating of the subjects according to the fifth criterion was accomplished by assigning to each subject a rating - from 1 to 5 - corresponding to the "strength" of that subject's reported subjective phenomenal experiences associated with feedback. On completion of each of a subject's 30 feedback sessions, a verbal report concerning these feedback-associated subjective experiences was elicited and recorded. In some instances it proved necessary for the subjects to transcribe their own descriptions. At the end of the experiment, the subjects were rated with respect to the "strength" of these subjective associations by the experimenter. The ratings were ranged along a continuum from 1 - which indicated that a subject had reported marked qualitative shifts in consciousness during most sessions - to 5 - which signified that a subject had reported no discernable alteration in conscious awareness at any stage. The ratings were made independently of the ratings the subjects received on the other criteria. The subjects ratings according to this criterion of "success" are shown in Table 4.

The rating of the subjects according to the sixth criterion was based upon

their/

their relative increase in differential alpha control from a pre-training to a post-training test-session (see section 5.3.1). These data are presented in Appendix J. A subject's differential alpha control over either test-session was obtained by dividing his "enhance" alpha time (in seconds) by his "suppress" alpha time. For example, S_7 produced 50 seconds of alpha during the 200-second "enhance" alpha trials as opposed to 75 seconds of alpha during the 200-second "suppress" alpha trials in the pre-training test-session. This constituted a pre-training differential alpha control score of 0,66 (i.e., the enhance/suppress alpha ratio). Similarly, S_7 's post-training differential alpha control score was 1,63 (52/32). The relative increase in differential alpha control is expressed in terms of the post-training differential alpha control score divided by the pre-training differential alpha control score. For S_7 , therefore, this would be $1,63 / 0,66 = 2,43$. The magnitude of this last figure is directly related to the relative increase in differential alpha control with positive values being indicative of enhanced control and negative values of diminished control. Table 3 presents the results of the subjects on this index. The 20 subjects were assigned a rating of from 1 to 4 (with 5 subjects being assigned to each rating) on the basis of the magnitude of their scores on this index. The higher the score, the lower the assigned rating. The ratings of the subjects according to this criterion are displayed in Table 4.

The rating of the subjects according to the fourth criterion was accomplished by assigning to each of the 20 subjects a rating - from 1 to 4, with 5 subjects per rating - on the basis of their increase in percentage time alpha in z-scores from the pre-training rest conditions to the post-training experimental (or alpha feedback) conditions. Table 4 shows the ratings of the subjects according to this criterion of "success" at alpha feedback training. It was according to this criterion that the alpha feedback group was divided into "successful" and "unsuccessful" sub-groups. Those subjects who achieved ratings of 1 or 2 were assigned to the "successful" alpha feedback group whilst those who achieved ratings of 3 or 4 were assigned to the "unsuccessful" alpha feedback group.

The decision to select the above criterion of "success" at alpha feedback training was based upon the following two sets of reasons. Firstly, it was chosen ahead of the other 3 criteria that were based upon change in alpha abundance (i.e., criteria 1 to 3) for motives similar to those underlying

the decision/

the decision to normalise the EEG data (see section 5.5). Secondly, because it was found that the ratings of the subjects according to this criterion were the most highly correlated with the ratings of the subjects according to the 5 alternative formulations for "success" (see Table 5). It constituted therefore the most representative of the six forms in which to express "success" at alpha feedback training.

5.6.2 The Novice Meditator Group: For analysis purposes, the novice meditator group was divided into a "regular" and an "irregular" meditator group on the basis of the subjects' self-ratings concerning their meditation regularity (see Appendix H). Subjects who received ratings of 1 or 2 were assigned to the "regular" group whilst those who received ratings of 3, 4 or 5 were assigned to the "irregular" group. Ratings of 6 or 7 resulted in the data of the subjects being excluded from the analysis. The two groups thus represented relatively high and low loadings on the crucial independent variable - regularity of meditation practice.

This form of control procedure was adopted in preference to that of comparing the "novice" meditators(longitudinally) with a non-meditating control group. This latter control procedure leads invariably to the confounding of the many meditation-associated factors (see section 3.2.4). The present control procedure was aimed at independently determining the efficacy of factors related to (cumulative) regular meditation practice.

TABLE 3

Scores of the alpha feedback subjects with respect to "differential alpha control increase" from a pre-training to a post-training test-session

Subject	Alpha Control Increase Score
1	11.76
2	1.58
3	34.65
4	3.89
5	-0.67
6	$-\infty$
7	2.43
8	-0.04
9	3.48
10	1.07
11	0.76
12	-0.31
13	1.52
14	1.76
15	4.28
16	∞
17	∞
18	-0.69
19	4.12
20	2.87

TABLE 4

Ratings of the alpha feedback subjects on the following criteria of "success" at alpha feedback: "the experimenter's rating" (X1), "the alpha z-Score change rating" (X2), "the alpha control rating" (X3), "the absolute alpha change rating" (X4), "the relative alpha change rating" (X5) and "the absolute alpha change/post-training alpha level rating" (X6)

Criteria	X1	X2	X3	X4	X5	X6
Subjects						
1	5	4	1	4	4	4
2	5	4	3	4	4	4
3	2	2	1	2	3	3
4	1	2	2	1	1	2
5	4	2	4	3	2	1
6	3	1	4	3	2	1
7	4	3	2	3	4	4
8	5	4	4	4	4	4
9	1	1	2	1	2	1
10	2	1	3	1	2	1
11	5	4	3	4	4	4
12	1	3	4	2	1	2
13	3	2	3	1	1	2
14	4	3	3	3	3	3
15	2	3	2	2	3	3
16	1	1	1	3	2	1
17	5	4	1	4	3	3
18	4	3	4	2	1	2
19	3	1	1	2	1	2
20	1	2	2	1	3	3

TABLE 5

Pearson correlation matrix for the rankings of the alpha feedback subjects according to the following variables: "the experimenter's rating" (X1), "the alpha z-Score change rating" (X2), "the alpha control rating" (X3), "the absolute alpha change rating" (X4), "the relative alpha change rating" (X5) and "the absolute alpha change/post-training alpha level rating" (X6)

	X1	X2	X3	X4	X5	X6
X1	-	.7151	.1897	.8027	.5692	.5984
X2		-	.12	.68	.64	.84
X3			-	.04	-.16	-.16
X4				-	.68	.56
X5					-	.8
X6						-

6.0 THE ALPHA FEEDBACK INVESTIGATION

6.1 Results

6.1.1 EEG Results: As previously described (see section 5.5), the EEG data used in the statistical analyses are in the form of transformed normative EEG data - i.e., in terms of percentage time occurrence of predetermined EEG spectrum bands.

Table 6 presents the results of the "successful" and "unsuccessful" alpha feedback groups over the pre-experimental rest condition, the experimental (or alpha feedback) condition and the post-experimental rest condition on Percentage Time Alpha in z-scores. (The base for the z-score conversion was the pre-training rest conditions.) The analysis of variance indicated a significant difference between the two groups ($P < .05$), a significant difference between the three conditions ($P < .01$) and a significant interaction effect ($P < .05$). Closer examination of the data through simple main effects revealed significant differences between the two groups for the experimental condition ($P < .01$) and the post-experimental rest condition ($P < .01$) and a significant difference between the three conditions for the "successful" alpha feedback group ($P < .01$). Specifically, the Tukey HSD comparisons showed a significant difference between the mean of the pre-experimental rest condition and the means of the experimental condition ($P < .01$) and the post-experimental rest condition ($P < .05$) for the "successful" alpha feedback group. In addition, the mean of the base (i.e., the pre-training rest condition) was shown to be significantly different to the means of the pre-experimental rest condition ($P < .05$), the experimental condition ($P < .01$) and the post-experimental rest condition ($P < .01$) for the "successful" alpha feedback group.

The results of the "successful" and "unsuccessful" alpha feedback groups over the pre-experimental rest condition, the experimental condition and the post-experimental rest condition on Percentage Time Beta, High Alpha and Low Alpha were similarly examined by two-way analyses of variance. With the exception of one significant "condition" effect, no significant effects were obtained. F Ratios for

Beta: A(groups) = 0,9156; B(conditions) = 1,371; A x B (interaction) = 1,84

High Alpha: A = 0,7474; B = 2,411; A x B = 0,9328

Low Alpha: A = 0,9455; B = 5,387*; A x B = 0,8385.

6.1.2 Heart-Rate/

6.1.2 Heart-Rate Results: Table 7 presents the results of the "successful" and "unsuccessful" alpha feedback groups over the pre-experimental rest condition, the experimental condition and the post-experimental rest condition on Heart-Rate. The analysis of variance indicated a significant difference between the three conditions for the two groups ($P < .01$). Closer examination through simple main effects revealed a significant difference between the three conditions for the "successful" alpha feedback group ($P < .05$). Specifically, the Tukey HSD comparisons showed a significant difference between the mean of the pre-experimental rest condition and the mean of the post-experimental rest condition for the "successful" alpha feedback group ($P < .01$).

6.1.3 Autonomic Balance Results: Table 8 deals with the results of the "successful" and "unsuccessful" alpha feedback group over the pre- and post-experimental condition tests for Autonomic Balance ($\bar{A}$). The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects revealed a significant difference between the two test-sessions for both the "successful" ($P < .01$) and the "unsuccessful" ($P < .05$) alpha feedback groups.

Table 9 shows the results of the two groups over the pre- and post-experimental condition test-sessions on Heart Period. The analysis of variance indicated a significant interaction effect ($P < .05$). Closer examination through simple main effects revealed a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .01$).

Table 10 presents the results of the two groups over the two test-sessions on Respiration Period. The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .01$).

The results of the two groups over the two test-sessions on Dermographia Persistence, Salivary Output, Palmar Conductance, Pulse Pressure and Volar Conductance were similarly examined by two-way analyses of variance. With the exception of one significant "condition" effect, no significant effects were obtained. F Ratios for

Dermographia Persistence: $A = 0.0213$; $B(\text{test-sessions}) = 2.731$;

$A \times B = 0.2737$

Salivary Output/

Salivary Output: $A = 0,0438$; $B = 4,710^*$; $A \times B = 0,1217$
 Palmar Conductance: $A = 0,0423$; $B = 0,9746$; $A \times B = 1,642$
 Pulse Pressure: $A = 0,7583$; $B = 0,0043$; $A \times B = 1,657$
 Voilar Conductance: $A = 0,0049$; $B = 0,2513$; $A \times B = 0,4015$

Closer examination of the significant effect - a significant difference between the two test-sessions for the groups on Salivary Output - through simple main effects indicated no significant effects.

6.1.4 Reaction-Time Results: An examination of the results of the "successful" and "unsuccessful" alpha feedback groups over the pre- and post-experimental condition tests on Reaction-Time through two-way analysis of variance revealed no significant effects (F Ratios: $A = 0,1387$; $B = 2,900$; $A \times B = 0,1359$).

6.1.5 Short-Term Memory/Perceptual Speed Results: An examination of the results of the "successful" and "unsuccessful" alpha feedback groups over the pre- and post-experimental condition tests on Short-Term Memory/Perceptual Speed through two-way analysis of variance revealed no significant effects (F Ratios: $A = 2,006$; $B = 0,1948$; $A \times B = 0,0095$).

6.1.6 Psychological Test Results: Table 11 presents the results of the "successful" and "unsuccessful" alpha feedback groups over the pre- and post-training test-sessions on the Barber Suggestibility Scale. The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < ,05$). Closer examination through simple main effects revealed no significant effects although the difference between the two test-sessions fell marginally short of significance for the "successful" alpha feedback group ($P < ,06$).

Table 12 presents the results of the two groups over the pre- and post-training test-sessions on the Stanford Hypnotic Susceptibility Scale. The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < ,05$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < ,05$).

Table 13 deals with the results of the two groups over the two test-sessions on the Marlowe-Crowne Social Desirability Scale. The analysis of variance

indicated/

indicated a significant interaction effect ($P < .05$). The simple main effects analysis revealed a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .01$).

Table 14 shows the results of the two groups over the two test-sessions on the EPI (N). The analysis of variance revealed a significant difference between the two test-sessions for the two groups ($P < .05$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .05$).

Table 15 deals with the results of the two groups over the two test-sessions on Construct Six of the Repertory Grid (Involved/Apathetic). The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .05$). The simple main effects analysis revealed a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .05$).

Table 16 presents the results of the two groups over the two test-sessions on Construct Ten of the Repertory Grid (Active/Passive). The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < .01$). The simple main effects analysis revealed a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .05$).

The results of the two groups over the two test-sessions on the Taylor Manifest Anxiety Scale, the EPI (E) and on Repertory Grid Constructs One, Two, Three, Four, Five, Seven, Nine, Eleven, Twelve, Thirteen, Fourteen and Fifteen were also examined by two-way analyses of variance. In all but two instances, no significant effects were obtained. F Ratios for

Taylor Manifest Anxiety Scale:	A = 0,0890; B = 1,085; A x B = 2,441
EPI (E):	A = 0,0418; B = 0,0351; A x B = 0,3162
Construct 1:	A = 5,234*; B = 0,5866; A x B = 0,7576
Construct 2:	A = 1,414; B = 0,4368; A x B = 0,1525
Construct 3:	A = 0,6386; B = 0,0291; A x B = 0,0200
Construct 4:	A = 0,330; B = 0,9460; A x B = 0,8381
Construct 5:	A = 0,0055; B = 3,145; A x B = 1,061
Construct 7:	A = 2,579; B = 3,574; A x B = 0,5117
Construct 9:	A = 5,766*; B = 0,0054; A x B = 0,1357

Construct 11/

Construct 11:	A = 2,385 ; B = 2,864 ; A x B = 0,054
Construct 12:	A = 1,442 ; B = 0,2388 ; A x B = 0,0017
Construct 13:	A = 3,358 ; B = 1,553 ; A x B = 0,0010
Construct 14:	A = 0,0047 ; B = 0,0055 ; A x B = 0,9251
Construct 15:	A = 1,769 ; B = 0,2675 ; A x B = 0,0930

The two significant effects (for Constructs One and Nine) both involved differences between the two groups that existed prior to training.

6.1.7 Phenomenological Repertory Grid Results: Table 40 (see section 8.1) presents the results of an analysis of the scores of the "successful" alpha feedback group (as defined by "the experimenter's rating" criterion of "success" - see section 5.6.1) on the constructs of the Phenomenological Repertory Grid. A Tukey HSD statistical analysis was carried out in order to determine the level of significance at which the group's mean scores on the constructs were different from zero. The Tukey HSD comparisons indicated that the group's mean scores on the following constructs were significantly different from 0:

1	(Has most breath-slowng/Has least breath slowing)	(P<,05)
4	(Finds it most harmful/Finds is least harmful)	(P<,05)
5	(Experiences most time-slowng/Experiences least time-slowng)	(P<,01)
6	(Finds it most anxiety-evoking/Finds it least anxiety-evoking)	(P<,01)
7	(Experiences and Behaves most like I would wish to/ Experiences and Behaves least like I would wish to)	(P<,01)
10	(Finds it least physically-relaxing/Finds it most physically-relaxing)	(P<,01)
11	(Experiences most breath-slowng/Experiences least breath-slowng)	(P<,05)
16	(Finds it most pleasant/Finds it least pleasant)	(P<,05)
19	(Finds it most anxiety-reducing/Finds it least anxiety-reducing)	(P<,05)
21	(Experiences least heart-rate-slowng/Experiences most heart-rate-slowng)	(P<,05)
24	(Finds it most beneficial/Finds it least beneficial)	(P<,01)
25	(Experiences most time-speeding/Experiences least time-speeding)	(P<,01)
26	(Finds it least physically-tensing/Finds it most physically-tensing)	(P<,05)
28	(Has least physical-movement/Has most physical-movement)	(P<,05)

30	(Finds it least unpleasant/Finds it most unpleasant)	(P<,01)
32	(Has lowest alpha levels/Has highest alpha levels)	(P<,05)
34	(Has least floating-experiences/Has most floating-experiences)	(P<,01)

TABLE 6(a)

Means and standard deviations for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group			"Unsuccessful" Alpha Feedback Group		
	Pre-E.	Exp.	Post-E.	Pre-E.	Exp.	Post-E.
Mean	14.62	38.42	31.16	-.938	1.92	3.028
Standard Deviation	13.65	37.57	37.76	6.235	3.724	6.447
Number in Sample	10	10	10	10	10	10

TABLE 6(b)

Analysis of variance summary table for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	10718	10718	8.752**
Error	18	22042	1225	
<u>Within Subjects</u>				
B (Pre-Exp., Exp. and Post-Exp. Conditions)	2	1948	974.1	5.824**
A x B	2	1111	555.5	3.321*
Error	36	6021	167.2	

TABLE 6(c)

Simple main effects summary table for the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	1210	1210	2.329
A at B2	1	6660	6660	12.82**
A at B3	1	3958	3958	7.616**
Error	54	23063	519.7	
B at A1	2	2975	1488	8.895**
B at A2	2	83.75	41.88	.2504
Error	36	6021	167.2	

TABLE 6(d)

Tukey HSD comparisons* for the means of the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group (A2)

	A1B1	A1B2	A1B3	Base
Mean	14.62	38.42	31.16	0
A1B1	-	5.819**	4.045*	3.575*
A1B2		-	1.774	9.394**
A1B3			-	7.620**
Base				-

* DF = 4,36 for comparisons with base;

DF = 3,36 for all other comparisons.

	A2B1	A2B2	A2B3	Base
Mean	-.938	1.92	3.028	0
Base	ns	ns	.7404	-

* DF = 4,36 for all comparisons with base.

TABLE 7(a)

Means and standard deviations for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Heart-Rate for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group			"Unsuccessful" Alpha Feedback Group		
	Pre-E.	Exp.	Post-E.	Pre-E.	Exp.	Post-E.
Mean	73.75	72.61	70.57	78.92	76.49	76.69
Standard Deviation	6.365	6.936	5.784	8.715	8.764	9.093
Number in Sample	10	10	10	10	10	10

TABLE 7(b)

Analysis of variance summary table for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Heart-Rate for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	383.5	383.5	2.274
Error	18	3036	168.7	
<u>Within Subjects</u>				
B (Pre-Exp., Exp. and Post-Exp. Conditions)	2	75.63	37.81	7.500**
A x B	2	12.69	6.344	1.258
Error	36	181.5	5.042	

TABLE 7(c)

Simple main effects summary table for the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Heart-Rate for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	133.7	133.7	2.243
A at B2	1	75.26	75.26	1.263
A at B3	1	187.3	187.3	3.143
Error	54	3218	59.58	
B at A1	2	51.88	25.94	5.145*
B at A2	2	36.41	18.20	3.611
Error	36	181.5	5.042	

TABLE 7(d)

Tukey HSD comparisons* for the means of the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Heart-Rate for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

	A1B1	A1B2	A1B3
Mean	73.74	72.61	70.57
A1B1	-	1.606	4.479**
A1B2		-	2.873
A1B3			-

	A2B1	A2B3	A2B2
Mean	78.92	76.69	76.49
A2B1	-	3.141	3.422
A2B3		-	.2817
A2B2			-

* DF = 3,36 for all comparisons.

TABLE 8(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	71.63	75.77	70.06	72.73
Standard Deviations	6.262	6.251	8.837	7.728
Number in Sample	10	10	10	10

TABLE 8(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	53.13	53.13	.5196
Error	18	1840	102.2	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Session)	1	115.9	115.9	19.97**
A x B	1	5.375	5.375	.9258
Error	18	104.5	5.806	

TABLE 8(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	12.31	12.31	.2279
A at B2	1	46.20	46.20	.8552
Error	36	1945	54.03	
B at A1	1	85.69	85.69	14.76**
B at A2	1	35.64	35.64	6.139*
Error	18	104.5	5.806	

TABLE 9(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Heart Period for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	45.67	54.76	48.81	50.96
Standard Deviation	13.03	14.26	11.97	12.71
Number in Sample	10	10	10	10

TABLE 9(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Heart Period for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	1.094	1.094	.0034
Error	18	5746	319.2	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Sessions)	1	315.8	315.8	15.87**
A x B	1	120.4	120.4	6.049*
Error	18	358.3	19.90	

TABLE 9(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Heart Period for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	49.30	49.30	.2907
A at B2	1	72.20	72.20	.4258
Error	36	6105	169.6	
B at A1	1	413.1	413.1	20.76**
B at A2	1	23.11	23.11	1.161
Error	18	358.3	19.90	

TABLE 10(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Respiration Period for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	58.62	67.98	49.56	54.13
Standard Deviations	29.14	27.27	15.72	18.72
Number in Sample	10	10	10	10

TABLE 10(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Respiration Period for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	1312	1312	1.251
Error	18	18877	1049	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Sessions)	1	485.1	485.1	10.45**
A x B	1	57.31	57.31	1.235
Error	18	835.6	46.42	

TABLE 10(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Respiration Period for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	410.4	410.4	.7495
A at B2	1	959.1	959.1	1.752
Error	36	19712	547.6	
B at A1	1	438.0	438.0	9.437**
B at A2	1	104.4	104.4	2.250
Error	18	835.6	46.42	

Means and standard deviations for the pre-training and the post-training scores on the Barber Suggestibility Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	5.450	4.050	4.450	3.800
Standard Deviation	5.398	4.657	4.431	6.161
Number in Sample	10	10	10	10

TABLE 11(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Barber Suggestibility Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	3.906	3.906	.0753
Error	18	9.343	51.91	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	10.51	10.51	4.561*
A x B	1	1.406	1.406	.6105
Error	18	41.46	2.303	

TABLE 11(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Barber Suggestibility Scale for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	5	5	.1845
A at B2	1	.3125	.3125	.0115
Error	36	975.8	27.10	
B at A1	1	9.800	9.800	4.254
B at A2	1	2.112	2.112	.9171
Error	18	41.46	2.303	

TABLE 12(a)

Means and standard deviations for the pre-training and the post-training scores on the Stanford Hypnotic Susceptibility Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	4.100	5.800	3.500	3.900
Standard Deviation	3.315	4.686	3.866	4.533
Number in Sample	10	10	10	10

TABLE 12(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Stanford Hypnotic Susceptibility Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	15.63	15.63	.4894
Error	18	574.7	31.93	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	11.03	11.03	4.811*
A x B	1	4.225	4.225	1.844
Error	18	41.25	2.292	

TABLE 12(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Stanford Hypnotic Susceptibility Scale for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	1.800	1.800	.1052
A at B2	1	18.05	18.05	1.055
Error	36	615.9	17.11	
B at A1	1	14.45	14.45	6.305*
B at A2	1	.8000	.8000	.3491
Error	18	41.25	2.292	

TABLE 13(a)

Means and standard deviations for the pre-training and the post-training scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	13.60	11.40	9.800	9.900
Standard Deviation	4.766	5.232	5.653	5.934
Number in Sample	10	10	10	10

TABLE 13(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	70.23	70.23	1.258
Error	18	1005	55.84	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	11.03	11.03	3.949
A x B	1	13.22	13.22	4.737*
Error	18	50.25	2.792	

TABLE 13(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	72.20	72.20	2.463
A at B2	1	11.25	11.25	.3838
Error	36	1055	29.31	
B at A1	1	24.20	24.20	8.669**
B at A2	1	.0500	.0500	.0179
Error	18	50.25	2.792	

TABLE 14(a)

Means and standard deviations for the pre-training and the post-training scores on the EPI (N) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	10.50	8.200	11.30	10.70
Standard Deviation	4.378	3.824	6.378	6.413
Number in Sample	10	10	10	10

TABLE 14(b)

Analysis of variance summary table for the pre-training and the post-training scores on the EPI (N) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	27.23	27.23	.5094
Error	18	962.1	53.45	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	21.03	21.03	4.837*
A x B	1	7.225	7.225	1.662
Error	18	78.25	4.347	

TABLE 14(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the EPI (N) for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	3.200	3.200	.1107
A at B2	1	31.25	31.25	1.081
Error	36	1040	28.90	
B at A1	1	26.45	26.45	6.084*
B at A2	1	1.800	1.800	.4139
Error	18	78.25	4.347	

TABLE 15(a)

Means and standard deviations for the pre-training and the post-training scores on the Repertory Grid - Construct Six (Involved/Apathetic) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	.3450	.6640	.4130	.4520
Standard Deviation	.4638	.2268	.4052	.4163
Number in Sample	10	10	10	10

TABLE 15(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Repertory Grid - Construct Six (Involved/Apathetic) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	.0518	.0518	.2261
Error	18	4.127	.2293	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.3204	.3204	4.405 *
A x B	1	.1960	.1960	2.694
Error	18	1.309	.0727	

TABLE 15(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Repertory Grid - Construct Six (Involved/Apathetic) for the "Successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	.0231	.0231	.1531
A at B2	1	.2247	.2247	1.488
Error	36	5.436	.1510	
B at A1	1	.5088	.5088	6.994 *
B at A2	1	.0076	.0076	.1045
Error	18	1.309	.0727	

TABLE 16(a)

Means and standard deviations for the pre-training and the post-training scores on the Repertory Grid - Construct Ten (Active/Passive) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

	"Successful" Alpha Feedback Group		"Unsuccessful" Alpha Feedback Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	.3018	.5709	.1556	.3378
Standard Deviation	.4266	.2749	.4783	.3941
Number in Sample	11	11	9	9

TABLE 16(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Repertory Grid - Construct Ten (Active/Passive) for the "successful" alpha feedback group and the "unsuccessful" alpha feedback group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	.3563	.3563	1.411
Error	18	4.543	.2524	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.5290	.5290	8.614**
A x B	1	.0187	.0187	.3042
Error	18	1.105	.0614	

TABLE 16(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Repertory Grid - Construct Ten (Active/Passive) for the "successful" alpha feedback group (A1) and the "unsuccessful" alpha feedback group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	.1059	.1059	.6749
A at B2	1	.2690	.2690	1.715
Error	36	5.649	.1569	
B at A1	1	.3983	.3983	6.485*
B at A2	1	.1494	.1494	2.433
Error	18	1.105	.0614	

6.2 Summary of Results

6.2.1 Summary of EEG Results: The results indicated that the "successful" alpha feedback group demonstrated an operantly conditioned alpha enhancement that was significantly in excess of free-operant alpha levels. This was shown employing both between-subjects and within-subjects control procedures. In terms of the between-subjects control procedure, it was found that although there were no significant differences between the "successful" and "unsuccessful" alpha groups over the pre-experimental rest condition (or over the pre-training rest condition on which they were, by convention, equal), the "successful" group produced significantly more alpha than the "unsuccessful" group over both the experimental condition ($P < .01$) and the post-experimental rest condition ($P < .01$). Using a within-subjects control procedure, the "successful" (but not the "unsuccessful") group was found to have increased significantly in terms of alpha from their pre-experimental rest condition (a free-operant condition) to their experimental condition (an operant condition) ($P < .01$) and post-experimental rest condition (also a free-operant condition) ($P < .05$).

Another notable finding was that the "successful" alpha feedback group's significant increase in alpha from the pre-experimental rest condition to the experimental condition ($P < .01$) was maintained to a slightly attenuated, yet still significant extent into the post-experimental rest condition ($P < .05$).

Although tonal feedback for alpha enhancement was found to be significantly associated with alterations in alpha abundance, it was not found to be associated with significant changes within any of the other three EEG frequency bands examined. It should be noted, however, that the above statistical analysis was conducted on EEG data that were normalised using the longitudinal base (i.e., the pre-training rest condition data - see section 5.5). An analysis that employed EEG data that were normalised using the short-term base (i.e., the pre-experimental rest condition data) revealed significant changes in beta activity to accompany to the significant alpha changes (see section 8.1.1 - Table 25). Specifically, it was found that the "successful" alpha feedback group produced significantly less beta during the experimental condition than during either the pre-experimental rest ($P < .01$) or the post-experimental rest conditions ($P < .05$).

6.2.2 Summary of Heart-Rate Results: Although both the "successful" and

the/

the "unsuccessful" alpha feedback groups decreased progressively in terms of heart-rate over the pre-experimental rest, the experimental and the post-experimental rest conditions, only the decrease (from the pre- to the post-experimental rest condition) of the "successful" group actually reached significance ($P < .01$). No heart-rate changes related specifically to the experimental condition were obtained.

6.2.3 Summary of Autonomic Balance Results: The interspacing of a 20-minute alpha feedback condition between testings for autonomic balance was found to be associated with a significant shift toward parasympathetic dominance ($P < .01$). Although this shift from the pre- to the post-experimental condition test-session was found for both "successful" and "unsuccessful" groups, it was more obvious in the former group ($P < .005$ as opposed to $P < .05$).

The influence of alpha feedback practice on each of the 7 physiological tests that contributed toward $\bar{A}$ was also examined. The "successful" and "unsuccessful" alpha feedback groups produced significantly different changes with respect to Heart Period ($P < .05$). The Heart Period of the "successful", but not the "unsuccessful", alpha feedback group lengthened significantly when measured in the post-experimental as opposed to the pre-experimental condition test-session ($P < .01$). The interspacing of the experimental condition was also accompanied by a significant lengthening of Respiration Period ($P < .01$). This significant effect was due largely to the contribution of a significant increase in Respiration Period on the part of the "successful" ($P < .01$), but not the "unsuccessful", alpha feedback group.

Feedback for alpha enhancement was not found to be associated with any significant changes in Dermographia Persistence, Salivary Output, Palmar Conductance, Pulse Pressure or Volar Conductance.

Thus, the "successful" alpha feedback group was found to have produced a more marked parasympathetic shift in autonomic balance from the pre- to the post-experimental condition tests than the "unsuccessful" group. In addition, the interspacing of the experimental condition was significantly associated with a lengthening of both Heart and Respiration Periods for the "successful", but not the "unsuccessful", alpha feedback group.

6.2.4 Summary of Reaction-Time Results: Feedback for alpha enhancement was

found/

found to have no significant effect upon subjects' subsequent reaction-time performance.

6.2.5 Summary of Short-Term Memory/Perceptual Speed Results: Alpha feedback practise was found to have no significant effect upon subjects' subsequent performance on a short-term memory/perceptual speed task.

6.2.6 Summary of Psychological Test Results: The alpha feedback group as a whole decreased significantly with respect to "direct suggestibility" (see section 5.2.5) ($P < .05$). However, it was largely the change in the scores of the "successful", rather than the "unsuccessful", group that accounted for this overall effect ($P < .06$ for the "successful" group).

The alpha feedback group as a whole increased significantly from pre- to post-training with respect to "hypnotic susceptibility" ($P < .05$). Once again, this significant effect was largely the result of a significant increase in "hypnotic susceptibility" on the part of the "successful" ($P < .05$), but not the "unsuccessful", alpha feedback group.

The two groups were found to have produced significantly different changes with respect to their "need for approval" ($P < .05$) with the "successful", but not the "unsuccessful", group showing a significant decrease from pre- to post-training ($P < .01$).

The alpha feedback group decreased significantly with respect to "neuroticism" ($P < .05$). This significant effect obtained for the group as a whole was due largely to the influence of a significant decrease on the part of the "successful" ($P < .05$), but not the "unsuccessful", sub-group.

The alpha feedback group construed themselves to be significantly more "involved" (as opposed to "apathetic") and more "active" (as opposed to "passive") by the post-training test-session ($P < .05$ and $P < .01$ respectively). In both instances, however, these significant effects obtained for the group as a whole were due largely to the influence of significant changes on the part of the "successful", but not the "unsuccessful", sub-group ($P < .05$ in both instances).

Thus, the "successful", but not the "unsuccessful", alpha feedback group produced the following significant changes from pre- to post-training -

decreased/

decreased "suggestibility", "neuroticism" and "need for approval", increased "hypnotic susceptibility" and a change toward construing themselves as more "involved" and "active".

6.2.7 Summary of Phenomenological Repertory Grid Results: The "successful" alpha feedback group (as defined by "the experimenter's rating" criterion) construed their feedback practices to have been significantly accompanied by a decrease in respiration rate ($P < .05$), a decrease in heart-rate ($P < .05$), a decrease in physical-motility ($P < .05$), a decrease in physical "tenseness" ($P < .05$) and an increase in physical relaxation ($P < .01$). They also construed their practices to have been "pleasant" ($P < .05$), "anxiety-reducing" ($P < .05$), "beneficial" ($P < .01$) and "much as they would have wished them to have been" ($P < .01$). They were not construed to have been "harmful" ($P < .05$), nor "anxiety-evoking" ($P < .01$), nor "unpleasant" ($P < .01$). Finally, the group construed their practices to have been accompanied by an apparent "time-slowness" ($P < .01$ for two constructs), by "the experience of floating sensations" ($P < .01$) and by enhanced alpha levels ($P < .05$).

6.3 Discussion

One of the aims of the present study was to attempt to demonstrate the phenomenon of operant alpha enhancement. It was assumed that the phenomenon would be demonstrated to the extent that the data of the present study were shown to have met Katkin and Murray's (1968) three minimal criteria for the acceptability of evidence for operant conditioning (see section 2.1). The three criteria will be applied systematically to the present data and experimental design.

Katkin and Murray's first criterion demands "some demonstration that the response being reinforced shows an increase in frequency, or amplitude, or probability over the level shown in the free-operant period." The criterion was clearly met by the present data (see section 6.2.1). From a within-subjects point of view, it was shown that the alpha (i.e., percentage time alpha in z-scores) level of the "successful" alpha feedback group was significantly higher in their operant condition (i.e., experimental condition) than in their free-operant condition (i.e., pre-experimental rest condition). From a between-subjects point of view, it was shown that the experimental condition alpha level of the "successful" alpha feedback group (i.e., a high operant group) significantly exceeded that of the "unsuccessful" alpha feedback group (i.e., a low operant group). (The groups were no different

over/

over the pre-experimental rest condition.)

The finding, from a within-subjects point of view, that the post-experimental rest condition (i.e., apparently a free-operant condition) alpha level failed to drop significantly below that of the experimental condition (or operant condition) may appear to be contradictory to the requirements of this criterion. It might similarly have been expected, from the between-subjects viewpoint, that the significant difference between "high and low operant groups" during the experimental condition should have dissipated by the post-experimental rest condition. That this was not found was due to the fact that the "successful" alpha feedback group's significant increase in alpha from the pre-experimental rest condition to the experimental condition was maintained to a slightly attenuated, yet still significant, extent into the post-experimental rest condition. This finding may be seen to correspond to what Kamiya (1969) termed the "preferred mode of waiting" (see section 2.1). He maintained that since the alpha mode was pleasant, subjects preferred to rest in a high alpha state even when not receiving feedback (assuming, of course, that they had previously learned to enhance their alpha levels). But he also observed that subjects had a tendency to continue producing whatever EEG response they had previously learned in operant conditions in subsequent free-operant conditions. In terms of the operant paradigm, these findings are not unexpected. What seems to have occurred is that on the withdrawal of the reinforcement, the subjects still continued to respond at a high level (on the previously reinforced response) for some time until, under the influence of extinction, response levels started to be depressed. In the present study, there were trends to indicate that the post-experimental rest condition alpha level may have been lower than that of the experimental condition (see section 6.1.1 - Table 6). In the light of the above interpretation, the post-alpha feedback rest condition should not be considered to be a free-operant condition in the same sense as the pre-alpha feedback rest condition. It seems rather to be a free-operant condition that is contaminated by the preceding operant condition and is thus not compatible with what Katkin and Murray (1968) term a free-operant condition.

Katkin and Murray 's second criterion - namely, that "the experimental design should allow comparisons between experimental groups and appropriate control groups" - was also clearly satisfied by the present experimental design. Not only did the design include an experimental and control group but it also

permitted/

permitted each experimental subject to act as a self-control (see section 5.6.1). The experimental and control groups comprised subjects differing with respect to their loading on the crucial independent variable - level of "success" at feedback-associated alpha enhancement. The criterion of "success" was related to the subjects' ability to enhance their alpha abundance over the long-term. This should be distinguished from the focus of the present study where the subjects' ability to enhance their alpha levels (or demonstrate operant alpha enhancement) over the short-term is being evaluated. The within-subjects control procedure permitted each subject's experimental data (i.e., operant EEG data) to be related to his own control or baseline data (i.e., free-operant EEG data).

The third of Katkin and Murray's criteria - namely, that " ... the data should be, within reasonable limits, free of obvious alternative explanations" - is probably the most difficult to clearly satisfy. One alternative explanation for the phenomenon of feedback-associated alpha enhancement is that alpha abundance increases, not as a function of reinforcement, but instead as a function of the subjects' increasing adaptation to the experimental situation (see section 2.4.3). Subjects' fears and apprehensions concerning the forthcoming experiment appear to have the capacity to artificially depress alpha levels during the earlier stages of an experiment (Lynch & Paskewitz, 1971). The alpha enhancement subsequently observed might simply be a reflection of the dissipation of these alpha-inhibitory factors. In the present experiment, a number of controls were adopted to minimise the potentially contaminating influence of these factors. First, subjects were subjected to an hour-long adaptation-session prior to their being exposed to any experimental sessions. Second, the short-term data presently being evaluated were obtained after the subjects had already undergone at least 30 previous hour-long experimental sessions. Finally, prior to any given experimental session, subjects were allowed a few minutes to adapt to the laboratory situation. It would thus appear that considerable care was taken to ensure the "adequate" adaptation of subjects prior to the recording of experimental data.

Another alternative explanation for the phenomenon is that the apparent operant alpha increase is mediated by the operant conditioning of some other voluntary response or responses (Skinner, 1938) (see section 2.4.3). Lynch and Paskewitz (1971), in their review of the mechanisms of alpha control, concluded that it " ... does seem apparent, however, (that) alpha activity is mediated by a whole host of factors, and the likelihood of ever controlling

or eliminating/

or eliminating all these factors to observe only simple alpha conditioning is extremely small." As previously discussed in section 2.4.3, at least three sets of voluntary responses are thought to have the capacity to mediate changes in alpha - alterations in cognitive mode (Green, Green & Walters, 1971), changes in affective arousal (Nideffer, 1973) and changes in oculomotor efferent activity (Mulholland, 1968, 1969a, b, 1972; Mulholland & Peper, 1971; Peper, 1971, 1972; Peper & Mulholland, 1970; Dewan, 1967). It has been convincingly demonstrated that the abolition of oculomotor efferent activity and its associated relaxation of the accommodation triad is a necessary, although not sufficient, condition for the presence of alpha activity. It furthermore seems quite likely that all instances of apparent operant alpha control are mediated via (possibly unconscious) control over this oculomotor efferent activity. Even alterations in cognitive mode and changes in affective arousal may exert their influence on alpha via this common mediational pathway.

Most of the phenomena in the field of alpha feedback appear to be compatible with the above interpretation. The phenomenon of apparent operant alpha suppression, which is both comparatively quick and easy to demonstrate (see section 2.4.1 & 2.4.2), may be interpreted as subjects having simply to learn to produce an already overlearned response - that of orienting - in the appropriate "suppress-alpha" experimental situations. It is the visual-motor component of the orienting response that is hypothesised to mediate the decrease in alpha. Apparent operant alpha enhancement, on the other hand, appears to be a far more difficult phenomenon to demonstrate as subjects have first to learn to produce the response that mediates alpha enhancement, and this response - non-orienting - is not within the normal behavioural repertoire of most subjects. Most instances of apparent differential alpha control were hypothesised to be a function, wholly or in part, of the learned alpha suppression component of the phenomenon (see section 2.4.3). Learned alpha enhancement is thought only to contribute, if at all, to the differential alpha control effect after a considerable amount of feedback training. The present study has provided, in fact, convincing evidence for the notion that differential alpha control is achieved largely by way of control over the mechanisms for alpha suppression. The correlation obtained between the ratings of the subjects according to "the alpha z-score change rating" criterion and "the alpha control rating" criterion was a low 0.12 (see section 5.6.1 - Table 5). This indicated

that there/

that there was little or no relationship between a subject's ability to demonstrate "differential alpha control" and his ability to demonstrate operant alpha enhancement. Anecdotal evidence was provided by the verbal reports of a number of the subjects. One subject, for example, who failed almost totally to raise her alpha levels over the course of the study - neither over the short- or the long-term - reported that she found it a relatively simple task to control her alpha; she simply visualised during "suppression" trials and ceased to visualise during "enhance" trials. The opposite was also reported with a subject, who was highly successful with respect to raising his alpha levels, having claimed to have had no idea at all how to "turn alpha off". The evidence points therefore toward the conclusion that differential alpha control may be largely a function of learned alpha suppression.

On the basis of the above discussion, it would appear that although the phenomenon of operant alpha enhancement was satisfactorily demonstrated, the effect seems almost certainly to have been a mediated one (possibly in the manner tentatively proposed above and in section 2.4.3). Only four previous studies appear to have adequately demonstrated the phenomenon of operant (-ly mediated) alpha enhancement - those of Brown (1970), Engstrom, London and Hart (1970a, b), Hord and Barber (1971) and Travis, Kondo and Knott (1972a). Many other studies that claimed to have demonstrated the phenomenon failed to meet Katkin and Murray's (1968) three minimal criteria for the acceptability of evidence for operant conditioning. For example, studies by Kamiya (1969), Hart (1967), Sach, Fenwick, et al, (1972), Honorton, Davidson and Bindler (1972), Walsh (1972) and Peper and Mulholland (1970) failed to show an operantly conditioned alpha enhancement that significantly exceeded free-operant alpha levels. Studies by Nowlis and Kamiya (1970) and by Green, Green and Walters (1969, 1970) were unacceptable in view of their failure to employ appropriate control procedures.

A second major aim of the present study was to determine the physiological, behavioural and psychological correlates of feedback training for alpha enhancement (see section 1.1). Over the short-term, the influence of feedback-associated alpha enhancement on occipital EEG alpha, beta, high (frequency) alpha and low alpha and on heart-rate was examined. In addition, the practice's effect upon subsequent resting autonomic balance measures

and upon/

and upon performance on reaction-time and short-term memory/perceptual speed tasks was investigated.

In addition to the previously discussed significant changes in alpha, the short-term practice of feedback for alpha enhancement was found also to be accompanied by significant changes within the beta frequency band (see sections 6.2.1 & 8.1.1 - Table 25). The "successful" alpha feedback group was found to produce significantly less beta during their experimental condition than during either their pre- or post-experimental rest conditions. No such significant changes were found within the high and low alpha frequency bands. An important implication of the above findings seems to be that the feedback-associated alpha enhancement was achieved largely at the expense of higher rather than lower EEG frequencies.

The present study failed to obtain any evidence for a relationship between operant alpha enhancement and changes in heart-rate. The heart-rates of all subjects appeared simply to decrease progressively as a function of the time they spent resting in the experimental situation. These findings seem to be consistent not only with the early observations of Kamiya (1962) but also with the more recent experimental work of Schwartz, Shaw and Shapiro (1971) who found that they could alter both alpha abundance and heart-rate independently. A difference emerged, however, with respect to the rates of heart-rate reduction shown by the "successful" and "unsuccessful" alpha feedback groups. The "successful" group was found to have produced a stronger time-dependent decrease in heart-rate than the "unsuccessful" group. A difference in ability to relax in the experimental situation may underly this apparent difference between the two groups. The finding may even reflect a difference between the two groups with respect to their ability to relax and cease orienting in the experimental situation - a finding supportive of Mulholland's oculomotor efferent theory of alpha (Mulholland, 1968, 1969a, b, 1972). It would have been valuable to know whether this difference between the two groups also manifested itself prior to the subjects' exposure to alpha feedback training. The additional data might have permitted a choice between two alternative explanations: (1) That pre-existing differences with respect to ability to relax in the experimental situation determined subjects' subsequent performance at feedback-associated alpha enhancement and consequently also determined the composition of the two groups; (2) That differences in performance at feedback-associated alpha enhancement (i.e., in "success" at alpha feedback) determined subjects'

subsequent ability/

subsequent ability to relax in the experimental situation.

With regard to the effect on autonomic balance of feedback for alpha enhancement, it was found that although both groups tended to shift significantly toward parasympathetic dominance following feedback, this parasympathetic shift was more marked for the "successful" alpha feedback group. This trend also manifested itself on the contributory physiological tests for Heart and Respiration Period. The present analysis failed, however, to establish whether the obtained positive relationship between "success" at alpha feedback and the magnitude of the parasympathetic shift was a function of (1) the "success" of the subjects at alpha enhancement; (2) a possible relationship between subjects' predisposition to "do well" at alpha feedback training and their ability to relax in the experimental situation; or (3) a combination of these two sets of factors. The problem might have been avoided had pre-training pre- and post-rest condition data as well as the post-training pre- and post-experimental condition data been examined by means of a 3×2 factorial analysis (i.e., a three-way analysis of variance). Although these data were, in fact, obtained, it was decided not to include them in the statistical analysis for it was felt that the pre-training pre-rest condition autonomic balance measures were contaminated. Since this was the subjects' first exposure to the tests, it seems probable that fears and apprehensions (concerning the tests) might have contributed toward artificially enhancing sympathetic levels.

A resolution of the above problem is of considerable importance since should the technique of feedback for alpha enhancement be shown to be associated with a subsequent significant parasympathetic shift in autonomic balance, it may possibly indicate a potential psychotherapeutic use for the technique - especially as a method of alleviating ailments with a strong "sympathetic" component.

Finally, feedback for alpha enhancement was found to have no significant effect over the short-term upon subjects' performance on a "three-choice discriminative reaction-time" task nor on a short-term memory/perceptual speed task.

Over the long-term, the psychological correlates of the regular practice of feedback for alpha enhancement were examined. The results indicated that the 6-weeks alpha feedback training was accompanied by decreases in "negative"

psychological/

psychological characteristics and increases in "positive" psychological characteristics. More specifically, it was found to be significantly accompanied by reductions in "suggestibility", "need for approval" and "neuroticism" and by increases in "hypnotic susceptibility" and in the tendency for subjects to construe themselves as "involved" (as opposed to "apathetic") and "active" (as opposed to "passive"). Each of these six longitudinal psychological changes were obtained for the alpha feedback group as a whole. It is of considerable importance to note, however, that in each instance it was a significant change on the part of the "successful" alpha feedback group, rather than the "unsuccessful" alpha feedback group, that contributed toward and was largely responsible for the overall significant effect (see section 6.1.6). This fact strongly suggests that the abovementioned significant correlates are closely related to the "success" exhibited by the subjects. (The "unsuccessful" alpha feedback group, it must be remembered, was not necessarily zero with respect to "success" but merely relatively lower than the "successful" group.) It is therefore concluded that the longitudinal psychological correlates of regular feedback for alpha enhancement were largely functionally related to the "success" achieved by the subjects at the task of enhancing their alpha levels over the long-term.

There was no evidence to suggest that the above effects were due to factors confounded with "success" at feedback-associated alpha enhancement. The significant decrease found with respect to "need for approval" undermines an alternative explanation for the data in terms of which it might simply be seen as a function of the subjects' increased need to respond in a manner thought desired by the experimenter. The role of the perceived "demand characteristics" (Orne, 1966, 1967) of the experimental situation appear thus to be minimal. That this was found was probably due to the fact that the experimenter had no prior expectations concerning the longitudinal psychological effects of alpha feedback training (except for "hypnotic susceptibility"), thus undoubtedly reducing the likelihood of covert communication of expectation to subjects. Some subjects probably had expectations but they were not subjected to any known form of systematic manipulation.

Some of the above findings - particularly the changes in "neuroticism" and in construed "involvement" and "activeness" - may indicate possible psychotherapeutic implications for the technique. This is, of course, consistent with the previously expressed view that alpha feedback training may prove

useful for/

useful for alleviating ailments with strong "sympathetic" components.

The significant decrease with respect to "need for approval" shown by the "successful", but not the "unsuccessful", group appears to be associated with a decreased need on the part of these subjects "to please the experimenter". In having "done well" at the alpha feedback task, these subjects may have felt that they had fulfilled their commitment to the experimenter and had thus less of a need to attempt to please him in other ways.

The obtained positive relationship between "success" at feedback-associated alpha enhancement and magnitude of increase in "hypnotic susceptibility" is congruent with the previously reported findings of Engstrom, London and Hart (1970a,b) (see section 2.3). They contend that this finding indicates a direct functional relationship to exist between hypnotic susceptibility and EEG alpha abundance and that it furthermore provides evidence for the hypothesis that hypnosis is a physiologically indexed altered state of consciousness. This hypothesis was criticised by the author (see section 2.3) who alternatively suggested that the findings might be the result of the enhancing influence of alpha feedback training on factors common to both high alpha levels and high "hypnotic susceptibility" (as measured on "relaxation-based" scales of hypnotisability such as the Stanford Susceptibility Scale - see section 5.2.5). Alpha feedback training for alpha enhancement was hypothesised to teach subjects "passive attentional" strategies - strategies that thereafter become available for generalisation to relaxation-hypnotic situations, thus enhancing "hypnotic susceptibility" in these situations. The present findings are consistent with this alternative explanation. Although alpha feedback training was found to be associated with significantly raised "hypnotic susceptibility", no increase in "direct suggestibility" (or waking suggestibility) (as measured by the Barber Suggestibility Scale - see section 5.2.5) was obtained. This is convincing evidence (in addition to that previously discussed in section 2.3) for the contention that feedback training for alpha enhancement raises "hypnotic susceptibility", not by its influence upon "suggestibility" per se, but rather via its influence on the subjects' ability to adopt passive attentional states during conditions necessitating relaxation.

A finding more difficult to explain was the fact that "direct suggestibility" did not appear to simply remain unchanged over the longitudinal period but,

in fact,/

in fact, seemed to show a strong trend toward decreasing. The significant decrease in "need for approval" may have contributed toward this effect. The fact, however, that this decrease in "need for approval" was not found to be capable of nullifying or reversing the increase in "hypnotic susceptibility" raises some doubt concerning the completeness of this explanation.

The short-term subjective concomitants of feedback-associated alpha enhancement were also investigated. This was accomplished by means of a statistical analysis of the post-training scores of a "successful" alpha feedback group on the constructs of the Phenomenological Repertory Grid (see Appendix K). It should be noted that this "successful" group was constituted according to a different criterion of "success" to that employed throughout the rest of the study (i.e., according to "the experimenter's rating" criterion - see section 5.6.1). It was selected because it was directly related to the "strength" of the subjects' feedback-associated subjective experiences. The correlation between the ranking of the subjects according to this criterion and according to the other criterion (i.e., "the alpha z-score change rating" criterion) was found, in any case, to be acceptably high ($r = 0,7158$).

The group's significant subjective data may be considered conveniently in three parts. First, they were found to have construed their alpha feedback practices to be accompanied by decreased respiration-rate, decreased heart-rate, decreased physical motility, decreased physical "tenseness" and increased physical relaxation. These subjective data may be seen to be consistent with those obtained from the short-term physiological investigation. That is, that "successful" feedback-associated alpha enhancement appeared to be significantly accompanied by a subsequent parasympathetic shift in autonomic balance. Second, they were found to have construed their practices to be "pleasant", "anxiety-reducing", "beneficial" and "much as they would have wished them to have been". They were not construed to be "harmful", nor "anxiety-evoking", nor "unpleasant". These data may be seen to be compatible with the findings of the longitudinal psychological investigation. That is, that the "successful" long-term practice of feedback for alpha enhancement appeared to be significantly associated with an enhancement in "positive" psychological characteristics and with a reduction in "negative" psychological characteristics. Finally, the groups were found to have construed their practice to be accompanied by an apparent "time-slowness" and by "the experience of floating sensations". These "private stimulus

concomitants" of feedback-associated alpha enhancement constitute convincing converging evidence from the subjective level of analysis for the contention that the practice is accompanied by a hypothetical altered state of consciousness.

The Phenomenological Repertory Grid analysis appears to have provided data that are remarkably consistent with those obtained at other levels of analysis. That is, the data obtained at this subjective level appears to converge with the data from the other levels toward similar conclusions (or hypotheses), thus enhancing the reliability of these conclusions.

Notwithstanding the problems associated with indexing states of consciousness using subjective data (see section 4.1), the present instrument appears to possess a number of advantages over the more conventional methods for assessing subjective material. The repertory grid is particularly unsusceptible to conscious faking on the part of subjects. It is thus largely free from the otherwise contaminating influence of subjects' responding in a socially-sanctioned manner (in the present context - responding in accordance with their "perceived demand characteristics" of the experimental situation). The only method available to a naive subject to purposely invalidate the data of this instrument is for him to respond randomly - a tactic easily detected. The employment of repertory grid techniques for the measurement of subjective data is recommended.

To summarise: "Successful" feedback-associated alpha enhancement was found to be associated over the short-term with significantly increased occipital alpha abundance, significantly decreased occipital beta abundance and with a subsequent parasympathetic shift in autonomic balance. There was also some evidence to suggest that it might be associated with a greater ability to relax in an experimental situation as reflected by faster rates of heart-rate reduction. Over the long-term, the "successful" practice of feedback-associated alpha enhancement was found to be significantly accompanied by decreased "suggestibility", decreased "need for approval", decreased "neuroticism", increased "hypnotic susceptibility" and by an increased tendency to construe oneself as "involved" and "active". Much of the findings of both the short-term and the long-term investigations were supported by data of a short-term subjective investigation.

7.0 THE TRANSCENDENTAL MEDITATION INVESTIGATION

7.1 Results

The results of the examination of the "advanced" meditator group over the short-term on EEG variables, heart-rate, autonomic balance, reaction-time and on short-term memory/perceptual speed are dealt with in sections 8.1.1 to 8.1.5. Although an examination limited to the "advanced" meditator group may have been conducted by employing one-way analyses of variance and t-tests, it was decided instead to utilise corresponding aspects from the statistical examination of the "successful" alpha feedback group and the "advanced" meditator group. This strategy avoided much replication in analysis of data.

7.1.1 EEG Results: Refer to section 8.1.1. Table 24 deals with the significant changes in Percentage Time Alpha in z-scores shown by the "advanced" meditator group.

7.1.2 Heart-Rate Results: Refer to section 8.1.2. Table 26 deals with the significant changes in Heart-Rate shown by the "advanced" meditator group.

7.1.3 Autonomic Balance Results: Refer to section 8.1.3. A significant change by the "advanced" meditator group on Pulse Pressure is dealt with in Table 29.

7.1.4 Reaction-Time Results: Refer to section 8.1.4.

7.1.5 Short-Term Memory/Perceptual Speed Results: Refer to section 8.1.5.

7.1.6 Psychological Test Results: Table 17 presents the results of the "regular" and "irregular" novice meditator groups over the pre- and post-training test-sessions on the Marlowe-Crowne Social Desirability Scale. The analysis of variance indicated no significant effects. The interaction effect, however, fell marginally short of significance.

Table 18 presents the results of the "regular" and "irregular" novice meditator groups over the pre- and post-training test-sessions on the Taylor Manifest Anxiety Scale. The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < 0.05$)

and a near-/

and a trend indicative of an interaction effect ($P < .06$). Closer examination of the data through simple main effects revealed a significant difference between the two groups over the post-training test-session ($P < .05$) and a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .01$).

Table 19 deals with the results of the two groups over the two test-sessions on the EPI (N). The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .01$).

Table 20 presents the results of the two groups over the two test-sessions on the EPI (E). The analysis of variance indicated a significant interaction effect ($P < .05$). Closer examination through simple main effects revealed a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .05$).

Table 21 deals with the results of the two groups over the two test-sessions on Construct Four of the Repertory Grid (Empathic/Non-Empathic). The analysis of variance revealed a significant difference between the two test-sessions for the two groups ($P < .05$). Closer examination through simple main effects showed a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .01$).

Table 22 presents the results of the two groups over the two test-sessions on Construct Five of the Repertory Grid (Least able to Concentrate/Most able to Concentrate). The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .05$). Closer examination through simple main effects revealed a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .05$).

The results of the two groups over the two test-sessions on the Barber Suggestibility Scale and on Repertory Grid Constructs One to Three and Six to Fifteen were also examined by two-way analyses of variance. With the exception of some significant "group" effects (i.e., A), no significant effects were found. F Ratios for

Barber Suggestibility Scale: A = 0,340; B = 2,193; A x B = 1,911

Construct 1/

Construct 1:	A = 0,194 ; B = 0,189 ; A x B = 0,499
Construct 2:	A = 0,024 ; B = 0,306 ; A x B = 0,140
Construct 3:	A = 4,472* ; B = 0,007 ; A x B = 0,180
Construct 6:	A = 0,265 ; B = 0,087 ; A x B = 0,056
Construct 7:	A = 0,023 ; B = 2,447 ; A x B = 1,253
Construct 9:	A = 0,0003 ; B = 0,085 ; A x B = 0,197
Construct 10:	A = 1,233 ; B = 1,088 ; A x B = 0,140
Construct 11:	A = 5,691* ; B = 0,749 ; A x B = 0,401
Construct 12:	A = 0,178 ; B = 1,284 ; A x B = 0,316
Construct 13:	A = 0,110 ; B = 0,729 ; A x B = 0,632
Construct 14:	A = 1,196 ; B = 0,019 ; A x B = 2,698
Construct 15:	A = 0,576 ; B = 0,818 ; A x B = 0,822

Table 23 presents a correlation matrix showing the results of Pearson correlations between changes on psychological test scores and the subjects' "meditation regularity rating" and changes on the Marlowe-Crowne Social Desirability Scale for the novice meditator group. A significant correlation was obtained between the regularity rating and the subjects' changes on the EPI (E) ($P < .01$). Strong relationships were obtained between the regularity rating and the changes on the Marlowe-Crowne Social Desirability Scale ($r = -0,356$), the Taylor Manifest Anxiety Scale ($r = 0,342$) and on Construct Fourteen of the Repertory Grid (Most confident/Least confident) ($r = -0,345$). In addition, a significant correlation was found between changes on the Marlowe-Crowne Social Desirability Scale and changes on Construct Four of the Repertory Grid (Empathic/Non-Empathic) ($P < .05$).

7.1.7 Phenomenological Repertory Grid Results: Table 40 (see section 8.1.9) presents the results of an analysis of the scores of the "advanced" meditator group on the constructs of the Phenomenological Repertory Grid. A Tukey HSD statistical analysis was carried out in order to determine the level of significance at which the group's mean scores on the constructs were different from zero (see Table 40). The Tukey HSD comparisons indicated that the group's mean scores on the following constructs were significantly different from 0:

Construct 10:	(Finds it least physically relaxing/Finds it most physically relaxing)	($P < .05$)
Construct 25:	(Experiences most time-speeding/Experiences least time-speeding)	($P < .05$)

Construct 30/

- Construct 30: (Finds it least unpleasant/Finds it most unpleasant) (P<,05)
- Construct 34: (Has least floating experiences/Has most floating experiences) (P<,01)

TABLE 17(a)

Means and standard deviations for the pre-training and the post-training scores on the Marlowe-Crowne Desirability Scale for the "regular" novice TM group and the "irregular" novice TM group

	"Regular" Novice TM Group		"Irregular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	14.33	16.00	14.31	13.00
Standard Deviation	5.394	6.176	5.186	3.873
Number in Sample	15	15	13	13

TABLE 17(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Marlowe-Crowne Desirability Scale for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	31.88	31.88	.6947
Error	26	1193	45.88	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	1.143	1.143	.1183
A x B	1	30.81	30.81	3.109
Error	26	251.1	9.656	

TABLE 18(a)

Means and standard deviations for the pre-training and the post-training scores on the Taylor Manifest Anxiety Scale for the "regular" novice TM group and the "irregular" novice TM group

	<u>"Regular"</u> Novice TM Group		<u>"Irregular"</u> Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	18.73	12.87	20.54	20.08
Standard Deviations	9.4	7.15	10.45	9.305
Number in Sample	15	15	13	13

TABLE 18(b)

Analysis of variance summary table for the pre-training the the post-training scores on the Taylor Manifest Anxiety Scale for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	283	283	2.009
Error	26	3663	140.9	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	157.8	157.8	6.415*
A x B	1	101.7	101.7	4.136
Error	26	639.5	24.60	

TABLE 18(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Taylor Manifest Anxiety Scale for the "regular" novice TM group (A1) and the "irregular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	22.69	22.69	.2743
A at B2	1	362.1	362.1	4.375*
Error	52	4303	82.75	
B at A1	1	258.1	258.1	10.49**
B at A2	1	1.387	1.387	.0564
Error	26	639.5	24.60	

TABLE 19(a)

Means and standard deviations for the pre-training and the post-training scores on the EPI (N) for the "regular" novice TM group and the "irregular" novice TM group

	"Regular" Novice TM Group		"Irregular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	12.07	8.933	13.23	11.62
Standard Deviations	5.483	4.217	4.711	5.501
Number in Sample	15	15	13	13

TABLE 19(b)

Analysis of variance summary table for the pre-training and the post-training scores on the EPI (N) for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	51.51	51.51	1.253
Error	26	1069	41.11	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	82.57	82.57	9.318**
A x B	1	8.023	8.023	.9054
Error	26	230.4	8.862	

TABLE 19(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the EPI (N) for the "regular" novice TM group (A1) and the "irregular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	9.437	9.437	.3777
A at B2	1	50.10	50.10	2.005
Error	52	1299	24.99	
B at A1	1	73.63	73.63	8.309**
B at A2	1	16.96	16.96	1.914
Error	26	230.4	8.862	

Means and standard deviations for the pre-training and the post-training scores on the EPI (E) for the "regular" novice TM group and the "irregular" novice TM group

	"Regular" Novice TM Group		"Irregular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	11.73	14.00	12.46	11.54
Standard Deviation	3.788	3.863	4.576	3.733
Number in Sample	15	15	13	13

TABLE 20(b)

Analysis of variance summary table for the pre-training and the post-training scores on the EPI (E) for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	10.46	10.46	.4112
Error	26	661.5	25.44	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	8.643	8.643	1.371
A x B	1	35.43	35.43	5.169*
Error	26	163.9	6.305	

TABLE 20(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the EPI (E) for the "regular" novice TM group (A1) and the "irregular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	3.691	3.691	.2326
A at B2	1	42.20	42.20	2.658
Error	52	825.4	15.87	
B at A1	1	38.53	38.52	6.112*
B at A2	1	5.538	5.538	.8783
Error	26	163.9	6.305	

TABLE 21(a)

Means and standard deviations for the pre-training and the post-training scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "regular" novice TM group and the "irregular" novice TM group

	<u>"Regular"</u> Novice TM Group		<u>"Irregular"</u> Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	.616	.238	.3569	.2823
Standard Deviation	.3859	.4577	.3739	.5492
Number in Sample	15	15	13	13

TABLE 21(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	.1606	.1606	.6530
Error	26	6.395	.2460	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.7873	.7873	5.222*
A x B	1	.3205	.3205	2.126
Error	26	3.920	.1508	

TABLE 21(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "regular" novice TM group (A1) and the "irregular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	.4674	.4674	2.356
A at B2	1	.0137	.0137	.0689
Error	52	10.32	.1984	
B at A1	1	1.072	1.072	7.107**
B at A2	1	.0362	.0362	.2400
Error	26	3.920	.1508	

TABLE 22(a)

Means and standard deviations for the pre-training and the post-training scores on the Repertory Grid - Construct Five (Least able to concentrate/Most able to concentrate) for the "regular" novice TM group and the "irregular" novice TM group

	"Regular" Novice TM Group		"Irregular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	.0180	-.273	-.035	-.198
Standard Deviation	.4804	.4347	.5039	.2995
Number in Sample	15	15	13	13

TABLE 22(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Repertory Grid - Construct Five (Least able to concentrate/Most able to concentrate) for the "regular" novice TM group and the "irregular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	.0015	.0015	.0064
Error	26	6.168	.2372	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.7498	.7498	5.088*
A x B	1	.0567	.0567	.3847
Error	26	3.831	.1474	

TABLE 22(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Repertory Grid - Construct Five (Least able to concentrate/Most able to concentrate) for the "regular" novice TM group (A1) and the "irregular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	.0198	.0198	.1032
A at B2	1	.0383	.0383	.1994
Error	52	9.999	.1923	
B at A1	1	.6337	.6337	4.300*
B at A2	1	.1729	.1729	1.173
Error	26	3.831	.1474	

TABLE 23

Pearson correlation matrix* for the "novice" TM group on the following variables:

<u>Changes on:</u>	Meditation Regularity Rating	M-C SD Scale Change
Regularity Rating	-	-.356
Barber SS	-.202	.4020
M-C SD Scale	-.356	-
Taylor MA Scale	.3420	-.268
EPI (N)	.0920	-.264
EPI (E)	-.537**	.1470
Rep. Grid - 1	.0230	-.029
Rep. Grid - 2	.0190	-.097
Rep. Grid - 3	.0350	-.063
Rep. Grid - 4	.1010	-.440*
Rep. Grid - 5	.1320	-.075
Rep. Grid - 6	.0780	-.131
Rep. Grid - 7	.1400	-.090
Rep. Grid - 9	.1130	-.258
Rep. Grid -10	.1220	.1580
Rep. Grid -11	.0980	-.030
Rep. Grid -12	.0010	.2140
Rep. Grid -13	.1750	-.135
Rep. Grid -14	-.345	-.030
Rep. Grid -15	-.120	-.157

* DF = 26 for all correlations

7.2 Summary of Results

7.2.1 Summary of EEG Results: Using a within-subjects experimental design, the "advanced" meditator group were found to have produced significantly less occipital alpha during their experimental condition than during either their pre-experimental rest ($P<.05$) or post-experimental rest conditions ($P<.01$). The corresponding short-term changes with respect to beta, although failing marginally to reach significance, tended to point toward the experimental condition being associated with more beta than either the pre- or the post-experimental rest conditions. No significant changes within the high or the low alpha frequency bands were found over these short-term experimental sessions (see section 8.1.1).

To summarise, the practice of Transcendental Meditation over the short-term was found to be significantly accompanied by reduced occipital alpha abundance and by a trend indicative of enhanced occipital beta activity.

7.2.2 Summary of Heart-Rate Results: The "advanced" meditator group decreased progressively in terms of heart-rate over the pre-experimental rest, the experimental and the post-experimental rest conditions. This resulted in the finding of a significantly slower heart-rate during the post-experimental rest condition than during the pre-experimental rest condition ($P<.01$). No evidence emerged to suggest that any changes in heart-rate might be related specifically to the experimental condition (see section 8.1.2 - Table 26).

7.2.3 Summary of Autonomic Balance Results: The interspacing of a 20-minute Transcendental Meditation condition between tests for Autonomic Balance determination was found to be associated with no significant changes (see section 8.1.3).

The short-term influence of the practice on each of the seven physiological parameters that contributed toward $\bar{A}$ was also examined. No significant changes were found on the measures for Dermographia Persistence, Salivary Output, Heart Period, Palmar Conductance, Volar Conductance and Respiration Period. Transcendental Meditation was found, however, to be associated with a significant subsequent lowering of Pulse Pressure ($P<.01$) (see section 8.1.3 - Table 29).

7.2.4 Summary of Reaction-Time Results: Transcendental Meditation was found to have no significant effect upon subjects' subsequent reaction-time performance (see section 8.1.4).

7.2.5 Summary of Short-Term Memory/Perceptual Speed Results: Transcendental Meditation was found to have no significant effect upon subjects' subsequent performance on a Short-Term Memory/Perceptual Speed task (see section 8.1.5).

7.2.6 Summary of Psychological Test Results: The novice meditator group as a whole decreased significantly with respect to "anxiety" from pre- to post-training ($P < .05$) (see section 7.1.6 - Table 18). This significant effect was due largely, however, to the influence of a significant decrease in "anxiety" on the part of the "regular" ($P < .01$), but not the "irregular", novice meditator group. In addition, although there was no difference between the two groups at pre-training, by post-training the "regular" group scored significantly lower with respect to "anxiety" than the "irregular" group ($P < .05$). These findings were also supported by those of a correlation analysis. Regularity of meditation practice was found to be highly correlated (although not quite significantly) with the magnitude of decrease in "anxiety" shown by the novice meditators ($r = 0.342$) (see Table 23).

The novice meditator group as a whole decreased significantly with respect to "neuroticism" ($P < .01$) (see Table 19). Once again, however, this significant effect was largely the result of a significant decrease in "neuroticism" on the part of the "regular" ($P < .01$), but not the "irregular", novice group.

The novice meditator group construed themselves to be significantly less "empathic" ($P < .05$) (see Table 21) and better "able to concentrate" ($P < .05$) (see Table 22) by their post-training test-session. In both instances, however, these significant effects obtained for the novice group as a whole were due largely to the influence of significant changes on the part of the "regular", but not the "irregular", sub-group ($P < .01$ and $P < .05$ respectively).

The two groups were found to have produced significantly different changes with respect to "extraversion" ($P < .05$) with the "regular", but not the "irregular", novice group obtaining a significant increase in "extraversion" ($P < .05$) (see Table 20). A correlation analysis similarly revealed regu-

larity/

larity of meditation practice to be significantly related to the magnitude of increase in "extraversion" shown by the novice meditator group ($P < .01$) (see Table 23).

An important trend emerged with respect to the changes obtained by the subjects on the Marlowe-Crowne Social Desirability Scale. The two groups were found to have produced marked different changes with respect to "need for approval". The "regular" novice meditator group increased in terms of this variable and the "irregular" novice group decreased (see Table 17). Although not statistically significant, these findings received additional support from the correlation analysis which revealed a strong tendency for regularity of meditation to be related to the magnitude of increase in "need for approval" obtained by the subject ($r = -0.356$) (see Table 23).

Thus, the "regular", but not the "irregular", novice meditator group produced the following significant changes from pre- to post-training - decreased "anxiety" and "neuroticism", increased "extraversion" and a change toward construing themselves as less "empathic" and better "able to concentrate". In addition, there was a strong trend associating "regularity of meditation" with the magnitude of increase in "need for approval".

7.2.7 Summary of the Phenomenological Repertory Grid Results: The "advanced" meditator group construed their Transcendental Meditation practice to be accompanied by an increase in physical-relaxation ($P < .05$). It was also construed to be not at all "unpleasant" ($P < .05$) and to be accompanied by an apparent "time-speeding" ($P < .05$) and by "the experience of floating sensations" ($P < .01$).

7.3 Discussion/

7.3 Discussion

The third major aim of the present study was to examine the occipital EEG correlates of Transcendental Meditation (see section 1.2). The results indicated that the practice of Transcendental Meditation over the short-term (by a group of teachers of the technique) was significantly associated with a reduction in occipital alpha abundance and possibly also with an elevation in occipital beta abundance. These results may appear to be at variance with the reported findings of previous researchers. Transcendental Meditation has been widely reported, for example, to be accompanied by reliable and progressive EEG changes - most notably, by an increase in alpha abundance and by a decrease in the average alpha frequency (Wallace, 1970a,b;; Wallace, Benson & Wilson, 1971; Wallace & Benson, 1972; Brown, Stewart & Blodgett, 1971, 1972; Timmons, Kamiya & Yeager, 1970; Doxey, 1972b - see section 3.1.1). On closer examination of the EEG data of these researchers, however, it emerges that the EEG changes were most prominent and possibly even restricted to the frontal scalp regions. In addition, recent studies by Banquet (1973), Touyz (1974) and Vassiliadis (1972) have provided tentative evidence for a possible beta increase and alpha decrease over the more posterior regions - particularly during the deeper stages of meditation. The present findings appear therefore to be consistent with the hypothesis that Transcendental Meditation may be accompanied by a forward migration of slower EEG activity toward the frontal channels and by an intensification of the lower voltage fast activity over the posterior regions. Alternatively, the present findings are also not inconsistent with the recently reported finding of Otis (1974) who was unable to distinguish meditation-associated EEG changes from those normally associated with light sleep - notably stage 1 sleep.

An additional finding of possible importance was the exceptionally high variance of the EEG data during the meditation (or experimental) condition (see Tables 24 and 25). This might indicate that not all the subjects were producing the same meditation-associated EEG changes. A tentative explanation for this lack of homogeneity may be that it reflected differences between the subjects with respect to their "depth of meditation". This view appears to receive some support from the within-subjects and anecdotal finding that reports of particularly "deep" meditations were found invariably to be accompanied by marked alpha suppression and beta intensification. More "superficial" meditations on the other hand, tended to be associated with less dramatic EEG alterations.

The major/

The major limitation of the above research was probably the fact that it was restricted to occipital EEG data. Potentially valuable EEG data were undoubtedly lost as a result of the failure to simultaneously examine frontal and central EEG channels. Had the present analysis been extended to include these data, it may have proved possible to determine whether the obtained intensification of occipital beta and reduction of alpha were, indeed, accompanied by the suspected intensification and slowing of frontal alpha activity. This more comprehensive form of EEG examination was not carried out due to the limited availability of certain apparatus - particularly additional EEG Spectrum Analysis Units (of which one per channel would have been required).

Notwithstanding the above limitation, the present findings were probably both relatively valid and reliable. Unlike the majority of studies reviewed in section 3.1.1, the present study: (1) employed apparatus that automatically analysed the EEG, thus avoiding the subjective bias associated with attempts to visually analyse EEG paper records (see Appendix M for validity and reliability data on the apparatus); (2) normalised the EEG data of each subject so that each subject's data would contribute more equal weight to subsequent statistical analyses (see section 5.5); (3) statistically analysed the normalised EEG data; (4) attempted to ensure that the subjects were "adequately" adapted to the experimental situation before obtaining any experimental data; (5) derived each subject's EEG data from not a single experimental session but from four sessions; and (6) used subjects who, being teachers of Transcendental Meditation, were probably particularly competent at the practice under examination.

The fourth major aim of the present study was to examine a number of the short-term physiological and behavioural concomitants of Transcendental Meditation (see section 1.2). Not only were the heart-rate correlates of Transcendental Meditation examined but, in addition, the subsequent effects of the practice on waking autonomic balance levels and upon performance on a reaction-time task and a short-term memory/perceptual speed task were investigated.

With respect to the heart-rate correlates of meditation, the results indicated that heart-rate simply decreased progressively as a function of time spent in the experimental situation. The experimental (or meditation) condition was not found to exert any influence upon this time-dependent heart-rate

decrease/

decrease. These results suggest that Transcendental Meditation (as practised by a group of teachers of the technique) was not associated with any significant changes in heart rate; that the obtained heart-rate reductions were instead simply related to the fact that the subjects were sitting quietly and relaxing. These findings add to an already confused situation regarding the influence of meditation on heart-rate. Previous researchers have reported highly contradictory findings (see section 3.1.4). Das and Gastaut (1955) and Leggett (1964) found meditation to be associated with increases in heart-rate while Bagchi and Wenger (1957), Vassiliadis (1972) (for relatively "inexperienced" practitioners) and Doxey (1972b) found no relationship to exist. Wallace (1970a, b), Wallace and Benson (1972), Vassiliadis (1972) (for relatively "more experienced" practitioners), Timmons, Kamiya and Yeager (1970), Walrath (in preparation) and Touyz (1974) on the other hand, reported meditation to be accompanied by a reduction in heart-rate. It should be borne in mind, however, that a number of these latter studies undoubtedly confounded the influence of meditation with that of simply sitting quietly and relaxing.

The results also indicated that the practice of Transcendental Meditation was unaccompanied by subsequent alterations in autonomic balance. This finding, that Transcendental Meditation was not followed by a hypometabolic physiological condition, does not in any way imply the absence (or the presence) of such a condition during actual meditation. As such, the present findings are not necessarily incompatible with Wallace, Benson and Wilson's (1971) view that Transcendental Meditation is accompanied by a hypometabolic state characterised by a parasympathetic shift in autonomic balance. In fact, on closer examination of the data of Wallace (1970a, b) and Wallace, Benson and Wilson (1971), it becomes apparent that very few of the meditation-associated physiological changes actually persisted after the termination of meditation (see section 3.1). This failure to obtain evidence for the persistence of a hypometabolic physiological condition after the termination of meditation raises some doubt concerning Wallace and Benson's (1972) proposal that Transcendental Meditation may exert a psychotherapeutic effect via this mechanism (see section 3.3.4). It is the author's contention that hypometabolism-related psychotherapeutic benefits will only materialise (if at all) to the extent that possible meditation-associated parasympathetic trends actually generalise to the non-meditative periods of the practitioners' lives. In the light of the present findings,

doubt is/

doubt is thus cast on the efficacy of this proposed mechanism for accounting for some of the reported Transcendental Meditation-associated psychotherapeutic benefits (Seeman, Nidich & Banta, 1972; Nidich, Seeman & Dreskin, in press; Nidich, Seeman & Seibert, in press; Hjelle, in press; Ferguson & Gowan, in press; Fehr, Nerstheimer & Tarber, 1972; Otis, 1973; Landrith, 1972; Graham, Peterman & Scarff, 1971; Boesse & Berger, 1972; Doucette, 1972; Ballou, 1973; Tjoa, 1972).

Only one of the seven physiological parameters that contributed toward the autonomic balance determination was found to have changed significantly following Transcendental Meditation. Pulse Pressure was found to have decreased. Unfortunately, since no previous study has reported having examined the relationship between meditation and pulse pressure, the present significant finding merely adds to the current lack of clarity concerning the influence of meditation on (a related variable) blood pressure (see section 3.1.2). Other parameters examined that were without precedent in the reviewed literature were dermographia persistence and salivary output. The present failure to obtain a post-meditation lengthening of heart period and elevation in palmar and volar conductance is partially consistent with previous research findings. Wallace (1970a, b) and Wallace and Benson (1972) reported, for example, that the meditation-associated heart-rate decrease reverted back to pre-meditation levels after the termination of meditation (see section 3.1.4). Similarly, meditation-associated increases in palmar skin resistance were reported to revert partially to pre-meditation levels after the termination of meditation (see section 3.1.5). The present findings with respect to respiration period, however, appear to contradict the earlier findings of these researchers. They reported that meditation was accompanied by a decrease in respiration-rate and that this decrease was maintained into the post-meditation rest period. (The present data were in this direction but fell short of reaching significance.)

As in the case of the EEG investigation, the major limitation of the autonomic balance examination appears to relate not so much to the obtained data but rather to the fact that potentially valuable data were excluded. That is, it would have been desirable to have obtained autonomic balance measures during, as well as before and after, the practice of meditation. These data were knowingly sacrificed, however, in order that Wenger's (1941, 1948, 1949, 1966) highly standardised method of autonomic balance determination might be employed. (Some of Wenger's physiological tests would undoubtedly have disrupted meditation.) It was thought that the benefits

to be derived/

to be derived from employing this very much more reliable form of analysis more than compensated for the data foregone (see section 5.3.2). The major advantages associated with the present autonomic balance investigation were: (1) Seven physiological parameters were employed that had previously been shown to be both valid and reliable indices of "autonomic balance"; (2) Data on these parameters were combined according to a recognised procedure to give an "autonomic balance" determination more reliable than that obtainable from any one of the parameters from which it was derived (see section 5.3.2); (3) Normative data on these parameters were derived for the present experimental population; (4) Subjects underwent two autonomic balance test-sessions prior to their exposure to the experimental test-sessions, thus habituating them to the otherwise unfamiliar and arousing tests; (5) Care was taken to ensure that the subjects were adequately rested before experimental data was obtained; (6) The subjects selected, being teachers of Transcendental Meditation, undoubtedly represented a particularly competent group of practitioners of the practice under investigation.

Transcendental Meditation has also been reported to be accompanied by an enhancement of perceptual-motor performance (Brown, Stewart & Blodgett, 1971; Blasdell, 1971; Shaw & Kolb, 1971), improved perceptual performance (Brown, Stewart & Blodgett, 1971; Graham, 1971) and by enhanced learning ability/intelligence (Abrams, 1972; Tjoa, 1972) (see sections 3.2.1 to 3.2.3). The present study found that the practice of Transcendental Meditation over the short-term had no significant effect upon subjects' performance on a "three-choice discriminative reaction-time" task (Slabler & Dyal, 1963) nor on a short-term memory/perceptual speed task. Since these negative findings were obtained using a relatively sophisticated experimental design, caution is urged in evaluating the positive findings of the previous preliminary and methodologically-suspect studies (see sections 3.2.1 to 3.2.3).

The fifth major aim of the present study was to explore the psychological concomitants of long-term regular Transcendental Meditation practice and to attempt to determine the role, if any, of changes in factors related to "need for approval" in bringing about measurable psychological changes (see section 1.2). The results indicated that 6 week's practice at Transcendental Meditation by a group of novice meditators was accompanied by decreases in "negative" psychological characteristics and increases in "positive" psychological characteristics. More specifically, the long-term practice

was found/

was found to be significantly accompanied by reductions in "anxiety" and "neuroticism", increases in "extraversion" and by an increased tendency to construe oneself as less "empathic"¹ and better "able to concentrate". Four of these five longitudinal psychological changes were obtained for the novice meditator group as a whole. (The change on "extraversion" was obtained only by the "regular" sub-group.) It is of considerable importance to note, however, that in each instance it was a significant change on the part of the "regular" novice meditator group, rather than the "irregular" novice meditator group, that contributed toward and was largely responsible for these overall significant effects (see section 7.2.6). In the case of "extraversion", although there was no significant change for the novice meditators as a whole, the "regular" novice group increased significantly. These findings strongly suggest that the above-mentioned significant correlates are closely related to the "regularity of meditation practice" exhibited by the subjects. (The "irregular" novice group, it must be remembered, was not zero with respect to "meditation regularity" but merely relatively less regular than the "regular" group.) It is therefore concluded that the longitudinal psychological correlates of Transcendental Meditation were largely functionally related to factors associated with the "regularity of meditation practice".

There is evidence to suggest, however, that the above effects might have been due not only to "regular meditation practice" but also to a set of factors confounded with "regularity of meditation practice". Two separate statistical analyses pointed toward a strong trend associating "regularity of meditation practice" with the magnitude of increase in "need for approval". Increases in "need for approval" might have contributed therefore toward the obtained "positive" psychological changes by either (1) indirectly influencing subjects' meditation regularity, or (2) by its possible direct effect on some of the psychological dimensions (particularly "anxiety" and "neuroticism" which are highly susceptible to changes in "need for approval" - see section 5.2.5 - Marlowe-Crowne Social Desirability Scale). The correlations obtained between the increase in "need for approval" and the increases in "anxiety" ($r = -0.268$) and "neuroticism" ($r = -0.264$) were in the direction and of the magnitude to suggest that increases in "need for approval" might, indeed, have directly contributed toward the obtained changes on these two psychological dimensions.

A highly/

¹ This apparently inconsistent finding may have arisen out of the frequently reported tendency for the subjects to misread "empathic" for "amphatic".

A highly tentative interpretation of the above findings follows. The relatively highly predisposed (toward Transcendental Meditation) subjects, as opposed to the relatively less predisposed subjects, might have been more susceptible to the "norms" and "expectancies" (or the "demand characteristics") of the Transcendental Meditation organisation as communicated to them via lectures, discussions, literature and the initiation ceremony. Their greater tendency to respond to the "Transcendental Meditation-associated social pressures" by adopting its "norms" and "expectancies" could have been reflected in a rise in their "need for approval" (as measured by the Marlowe-Crowne Social Desirability Scale) and in their more regular meditating. This heightened need for social approval (in the Transcendental Meditation context) may have contributed therefore toward both the regularity with which an individual practised meditation and toward his tendency to respond as less "anxious" and "neurotic" on pencil-and-paper psychological tests.

This interpretation may hold important implications for the teaching of Transcendental Meditation. Should it be desired that Transcendental Meditation's assumed psychotherapeutic properties be enhanced, then (1) only highly predisposed individuals should be initiated into the practice. This could be achieved by raising sufficiently the "cost" (not necessarily the economic cost) of learning the technique, and (2) more attention should be directed toward the systematic manipulation of factors in the Transcendental Meditation social setting that could raise the subjects' susceptibility to the Transcendental Meditation-associated "values", "norms" and "expectancies".

The present study, along only with those of Ballou (1973) and Otis (1973), may have provided evidence for the crucial role of non-time-dependent (or non-cumulative) factors, such as those that converge within the short period around the time that a subject first learns to meditate, in contributing toward the meditation-associated psychological changes. At the same time, no evidence was obtained to suggest that time-dependent factors were unimportant; on the contrary, factors associated with regular meditation practice were shown to be of central importance in contributing toward the Transcendental Meditation-associated psychological changes. (Changes in "need for approval" did not account for all the significant variance associated with "regularity of meditation practice".) The present tentative findings may therefore be seen to correspond to the alternative mechanism

proposed to/

proposed to account for Transcendental Meditation-associated "positive" psychological changes (see section 3.3.5).

In view of the present study not having obtained more conclusive and significant data on the relationship between changes in "need for approval" and (1) subjects' meditation regularity and (2) changes on certain psychological dimensions, it is recognised that the conclusions arrived at concerning the role of changes in "need for approval" in bringing about "positive" psychological changes are both highly tentative and contentious. The present findings point nevertheless toward an urgent need for further research into the problem since alterations in subjects' "need for approval" may be a crucial underlying cause for many of the Transcendental Meditation-associated psychological changes.

The two most consistently reported psychological concomitants of Transcendental Meditation are decreased "anxiety" (Nidich, Seeman & Seibert, in press; Hjelle, in press; Ferguson & Gowan, in press; Boesse & Berger, 1972; Doucette, 1971; Ballou, 1973) and decreased "neuroticism" (Ferguson & Gowan, in press; Tjoa, 1972; Fehr, Nerstheimer & Tarber, 1972). The similar findings of the present study simply underline the already high reliability of these phenomena; phenomena that have been established by different researchers using different psychological instruments and different experimental designs (see section 3.2.4). The conclusions of these earlier researchers might require reinterpretation, however, in the light of the tentative findings discussed above. That is, the possible role of changes in "need for approval" in contributing toward the changes on these two variables may need to be considered.

The obtained increase in "extraversion" on the part of the "regular" novice meditators appears to be compatible with Orme-Johnson's (in press) finding that regular meditators decreased significantly more than did irregular meditators on "social introversion" (see section 3.2.4). These findings are of importance in view of the claim made by many that meditation leads to "social withdrawal".

The obtained increase with respect to construed "ability to concentrate" and decrease with respect to construed "empathy" are without precedent in the reviewed literature (see section 3.2.4).

The short-term/

The short-term subjective concomitants of Transcendental Meditation were also investigated. This was accomplished by means of a statistical analysis of the scores of the "advanced" meditator group on the constructs of the Phenomenological Repertory Grid (see Appendix K). As in the case of the alpha feedback investigation (see section 6.3), the significant subjective data may be considered conveniently in three parts. First, the subjective data that are compatible with those obtained from the short-term physiological investigation. The only data of this description was that the group was found to construe their practice to be "physically-relaxing". These data are consistent with the view that although Transcendental Meditation may not be followed by a hypometabolic physiological condition, its actual practice may be associated with such a condition. Second, the subjective data that are congruent with those obtained from the longitudinal psychological investigation. The group was found to have construed their practice to be not at all "unpleasant" - data not inconsistent with the finding that Transcendental Meditation is associated with enhanced "positive" psychological characteristics. Finally, the subjective data that are compatible with the hypothesis that Transcendental Meditation is associated with an altered state of consciousness. The group was found to have construed their practice to be accompanied by an apparent "time-speeding" and by "the experience of floating sensations". The Phenomenological Repertory Grid appears therefore to have provided data that are somewhat consistent with those obtained at other levels of analysis (but less consistent than in the case of the alpha feedback investigation - see section 6.3).

To summarise: Transcendental Meditation, as practised by an "advanced" group of teachers of the technique, was found to be associated over the short-term with a significant reduction in occipital alpha abundance and by a trend indicative of enhanced beta abundance. No significant heart-rate correlates were observed. In addition, the practice was not found to be accompanied by any subsequent significant shift in autonomic balance nor by subsequent changes in performance on tasks for reaction-time and short-term memory/perceptual speed. Over the long-term, the regular practice of Transcendental Meditation by a group of novice meditators was found to be significantly accompanied by decreased "anxiety" and "neuroticism", increased "extraversion" and by an increased tendency to construe oneself as better "able to concentrate" and less "empathic". There was also

limited/

limited evidence to suggest that increases in "need for approval" might have contributed toward the obtained meditation-associated psychological changes either indirectly by its influence on subjects' meditation regularity or by a possible direct effect on some psychological dimensions (especially "anxiety" and "neuroticism"). The data of a short-term subjective investigation provided limited support for some of the findings of the short-term and long-term investigations.

8.0 THE COMPARATIVE MULTIDISCIPLINARY INVESTIGATION

8.1 Results

8.1.1 EEG Results: Table 24 presents the results of the "successful" alpha feedback group and the "advanced" meditator group over the experimental condition and the post-experimental rest condition on Percentage Time Alpha in z-scores. (The base for the z-score conversion was the pre-meditation rest condition. The two groups were thus, by convention, equal over this condition.) The analysis of variance indicated a significant interaction effect ($P < .05$). Closer examination of the data through simple main effects revealed a significant difference between the two groups over the experimental condition ($P < .05$) and a significant difference between the two conditions for the "advanced" meditator group ($P < .01$). In addition, Tukey HSD comparisons showed a significant difference between the mean of the base and the mean of the experimental condition for the "advanced" meditator group ($P < .05$).

Table 25 presents the results of the "successful" alpha feedback group and the "advanced" meditator group over the experimental condition and the post-experimental rest condition on Percentage Time Beta in z-scores. The analysis of variance indicated a significant interaction effect ($P < .05$). Closer examination of the data through simple main effects revealed a significant difference between the two groups over the experimental condition ($P < .05$) and a significant difference between the two conditions for the "successful" alpha feedback group ($P < .05$). In addition, Tukey HSD comparisons showed a significant difference between the mean of the base and the mean of the experimental condition for the "successful" alpha feedback group ($P < .01$).

The results of the "successful" alpha feedback group and the "advanced" meditator group over the experimental condition and the post-experimental rest condition on Percentage Time High Alpha in z-scores and on Percentage Time Low Alpha in z-scores were similarly examined by two-way analyses of variance. No significant effects were obtained. F Ratios for

High Alpha: A = 1,362 B = 1,297 A X B = 0,873

Low Alpha: A = 0,244 B = 2,129 A X B = 1,490

8.2.1 Heart-Rate/

8.1.2 Heart-Rate Results: Table 26 presents the results of the "successful" alpha feedback group and the "advanced" meditator group over the pre-experimental rest condition, the experimental condition and the post-experimental rest condition on Heart-Rate. The analysis indicated a significant difference between the three conditions for the two groups ($P < .01$). Closer examination of the data through simple main effects revealed a significant difference between the three conditions for both the "successful" alpha feedback group ($P < .01$) and the "advanced" meditator group ($P < .01$). Specifically, the Tukey HSD comparisons showed significant differences between the means of the pre-experimental rest and post-experimental rest conditions for both the "successful" alpha feedback group ($P < .01$) and the "advanced" meditator group ($P < .01$).

8.1.3 Autonomic Balance Results: Table 27 deals with the results of the "successful" alpha feedback group and the "advanced" meditator group over the pre- and post-experimental condition test-sessions on Autonomic Balance. The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .05$) and a significant interaction effect ($P < .05$). Closer examination of the data through simple main effects revealed a significant difference between the two groups over the post-experimental condition test-session ($P < .05$) and a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .01$).

Table 28 presents the results of the "successful" alpha feedback group and the "advanced" meditator group over the pre- and post-experimental condition test-sessions on Heart Period. The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < .01$) and a significant interaction effect ($P < .05$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .01$).

Table 29 presents the results of the two groups over the two test-sessions on Pulse Pressure. The analysis of variance indicated a significant difference between the two groups over the two test-sessions ($P < .05$) and a significant interaction effect ($P < .01$). Closer examination through simple main effects showed a significant difference between the two groups over the post-experimental condition test-session ($P < .01$) and a significant difference between the two test-sessions for the "advanced" meditator group ($P < .01$).

Table 30 deals with the results of the two groups over the two test-sessions on Respiration Period. The analysis of variance showed a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects revealed a significant difference between the two test-sessions for the "successful" alpha feedback group ($P < .05$).

The results of the two groups over the two test-sessions on Dermographia Persistence, Salivary Output, Palmar Conductance and Volar Conductance were similarly examined by two-way analyses of variance. No significant effects were obtained. F Ratios for

Dermographia Persistence:	A = 0,158	B = 1,932	A X B = 1,358
Salivary Output:	A = 0,0003	B = 2,856	A X B = 0,457
Palmar Conductance:	A = 0,009	B = 1,433	A X B = 0,007
Volar Conductance:	A = 0	B = 1,628	A X B = 1,979

8.1.4 Reaction-Time Results: An examination of the results of the "successful" alpha feedback group and the "advanced" meditator group over the pre- and post-experimental condition test-sessions on Reaction-Time through two-way analysis of variance revealed no significant effects (F Ratios: A = 2,506; B = 0,823; A X B = 1,033).

8.1.5 Short-Term Memory/Perceptual Speed Results: An examination of the results of the "successful" alpha feedback group and the "advanced" meditator group over the pre- and post-experimental condition test-sessions on Short-Term Memory/Perceptual Speed through two-way analysis of variance indicated no significant effects (F Ratios: A = 1,507; B = 0,002; A X B = 0,890).

8.1.6 Psychological Test Results: Table 31 deals with the results of the "successful" alpha feedback group and the "regular" novice meditator group over the pre- and post-training test-sessions on the Marlowe-Crowne Social Desirability Scale. The analysis of variance yielded a significant interaction effect ($P < .05$). Closer examination of the data through simple main effects indicated a significant difference between the two groups for the post-training test-session ($P < .05$).

Table 32 presents the results of the "successful" alpha feedback group and "regular" novice meditator group over the two test-sessions on the Taylor

Manifest Anxiety Scale. The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects showed a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .01$).

Table 33 presents the results of the two groups over the two test-sessions on the EPI (N). The analysis of variance yielded a significant difference between the two test-sessions for the two groups ($P < .01$). Closer examination through simple main effects indicated a significant difference between the two test-sessions for both the "successful" alpha feedback group ($P < .05$) and the "regular" novice meditator group ($P < .01$).

Table 34 deals with the results of the two groups over the two test-sessions on Construct Four of the Repertory Grid (Empathic/Non-Empathic). The analysis of variance indicated a significant difference between the two test-sessions for the two groups ($P < .05$) and a significant interaction effect ($P < .05$). Closer examination through simple main effects yielded a significant difference between the two test-sessions for the "regular" novice meditator group ($P < .01$).

The results of the two groups over the two test-sessions on the Barber Suggestibility Scale, the EPI (E) and on Repertory Grid Constructs One to Three and Five to Fifteen were also examined by two-way analyses of variance. With the exception of some significant "group" effects (i.e., A), no significant effects were obtained. F Ratios for

Barber Suggestibility Scale:	A = 0,443	B = 0,927	A X B = 0,871
EPI (E):	A = 0,677	B = 1,493	A X B = 3,116
Construct One:	A = 4,009	B = 0,101	A X B = 0,502
Construct Two:	A = 3,064	B = 1,314	A X B = 1,252
Construct Three:	A = 7,899*	B = 0,096	A X B = 0,079
Construct Five:	A = 0,966	B = 3,529	A X B = 4,033
Construct Six:	A = 2,071	B = 1,404	A X B = 1,821
Construct Seven:	A = 6,041*	B = 0,004	A X B = 0,967
Construct Nine:	A = 4,329*	B = 0,989	A X B = 0,007
Construct Ten:	A = 0,087	B = 2,898	A X B = 1,253
Construct Eleven:	A = 0,207	B = 0,913	A X B = 0,619
Construct Twelve:	A = 0,778	B = 0,456	A X B = 0,006
Construct Thirteen:	A = 1,468	B = 1,824	A X B = 0,117
Construct Fourteen:	A = 0,487	B = 2,095	A X B = 0,122
Construct Fifteen:	A = 4,707*	B = 0,990	A X B = 2,190

8.1.7 Hotelling's T-Square Analyses Results: Table 35 presents the results of an analysis of the change-scores (i.e., from the pre-experimental rest condition base to the experimental condition for Alpha, Beta, High Alpha and Low Alpha; from the pre-experimental rest condition to the experimental condition for Heart-Rate; from the pre- to the post-experimental condition test-session for Autonomic Balance, Reaction-Time and Short-Term Memory/Perceptual Speed) of the "successful" alpha feedback group and the "advanced" meditator group on eight (short-term) variables - Alpha, Beta, High Alpha, Low Alpha, Heart-Rate, Autonomic Balance, Reaction-Time and Short-Term Memory/Perceptual Speed. The Hotelling's T-Square Test for significance of overall differences between the two groups on the eight variables was significant ($P < .05$).

Table 36 deals with the results of an analysis of the change-scores (see above) of the "successful" alpha feedback group and the "advanced" meditator group on three (short-term) variables - Alpha, Beta and Autonomic Balance. The Hotelling's T-Square Test for the significance of overall differences between the two groups on the three variables was significant ($P < .05$).

Table 37 presents the results of an analysis of the change-scores (i.e., from the pre- to the post-training test-session) of the "successful" alpha feedback group and the "regular" novice meditator group on nine (long-term) psychological variables - "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activity". The Hotelling's T-Square Test for the significance of overall differences between the two groups on these nine variables was insignificant.

8.1.8 Stepwise Multiple Linear Regression Analyses Results: Table 38 presents the results of a Stepwise Multiple Linear Regression of the change-scores (see section 8.1.7) of the subjects in the "successful" alpha feedback group and the "advanced" meditator group on the eight (short-term) variables - Alpha, Beta, High Alpha, Low Alpha, Heart-Rate, Autonomic Balance, Reaction-Time and Short-Term Memory/Perceptual Speed. The analysis indicated that the change-scores of the subjects on the autonomic balance variable accounted for 21,75% of the variance of the subjects over the two groups (Multiple $RSQR = 0,2175$). The addition of the subjects' change-scores on the Alpha variable raised the variance accounted for to 31,19%. On the addition of the change-scores on High Alpha, this rose to 40,21%; on the addition of

the change/

the change-scores on Heart-Rate, to 51,31%; on the addition of the change-scores on Low Alpha, to 59,48%; on the addition of the change-scores on Reaction-Time, to 62,29%; on the addition of the change-scores on Beta, to 66,91%, and on the addition of the change-scores on Short-Term Memory/Perceptual Speed, to 68,45%. That is, the change-scores of the subjects on the eight variables accounted for 68,45% of the variance of the subjects over the two groups (Multiple RSQR = 0,6845).

Table 39 deals with the results of a Stepwise Multiple Linear Regression of the change-scores (see section 8.1.7) of the subjects in the "successful" alpha feedback group and the "regular" novice meditator group on nine (long-term) psychological variables - "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "ideal-self" and construed "sensitivity". The analysis indicated that the change-scores of the subjects on the "need for approval" variable accounted for 17,23% of the variance of the subjects over the two groups. The addition of the subjects' change-scores on the "ability to concentrate" variable raised the variance accounted for to 28,16%. On the addition of the change-scores on "extraversion", this rose to 40,61%; on the addition of the change-scores on "sensitivity", to 49,51%; on the addition of the change-scores on "anxiety", to 56,92%; on the addition of the change-scores on "suggestibility", to 57,87%; on the addition of the change-scores on "ideal-self", to 58,95%; on the addition of the change-scores on "neuroticism", to 59,42%, and on the addition of the change-scores on "empathy", to 59,48%. That is, the change-scores of the subjects over these nine psychological test variables accounted for 59,48% of the variance of the subjects over the two groups (Multiple RSQR = 0,5948).

8.1.9 Phenomenological Repertory Grid Results: Table 40 presents the results of the "successful" alpha feedback group (as defined by "the experimenter's rating criterion" of "success" - see section 5.6.1) and the "advanced" meditator group on their scores on the Phenomenological Repertory Grid. The analysis of variance indicated significant differences between the two groups with respect to their scores on the following constructs: Five (Experiences least time-slowness/Experiences most time-slowness) ($P < .05$); Six (Finds it most anxiety-evoking/Finds it least anxiety-evoking) ($P < .05$); Seventeen (Experiences most thoughts/Experiences least thoughts) ($P < .05$); Nineteen (Finds it most anxiety-reducing/Finds it least anxiety-reducing) ($P < .05$); Twenty-Five (Experiences most time-speeding/Experiences least

time-speeding/

time-speeding) ($P < .05$); Thirty (Finds it least unpleasant/Finds it most unpleasant) ($P < .05$); Thirty-Two (Has lowest alpha levels/Has highest alpha levels) ($P < .05$); Thirty-Four (Has most floating experiences/Has least floating experiences) ($P < .05$) and Thirty-Six (Experiences least loss of consciousness/Experiences most loss of consciousness) ($P < .05$).

TABLE 24(a)

Means and standard deviations for the experimental condition and the post-experimental condition measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group and the "advanced TM group"

	<u>"Successful"</u> Alpha Feedback Group		<u>"Advanced"</u> TM Group	
	Exp.	Post-Exp.	Exp.	Post-Exp.
Mean	2.839	.869	-12.34	2.64
Standard Deviation	4.840	6.488	21.76	9.872
Number in Sample	10	10	10	10

TABLE 24(b)

Analysis of variance summary table for the experimental condition and the post-experimental condition measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group and the "advanced TM Group"

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	449	449	2.648
Error	18	3053	169.6	
<u>Within Subjects</u>				
B (Exp. Condition/ Post-Exp. Condition)	1	423.3	423.3	2.849
A x B	1	718.4	718.4	4.836*
Error	18	2674	148.6	

TABLE 24(c)

Simple main effects summary table for the experimental condition (B1) and the post-experimental condition (B2) measures on Percentage Time Alpha in z-Scores for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	1152	1152	7.240*
A at B2	1	15.75	15.75	.0099
Error	36	5727	159.1	
B at A1	1	19.40	19.40	.1306
B at A2	1	1122	1122	7.554**
Error	36	5348	148.6	

TABLE 24(d)

Tukey HSD comparisons* for the means of the experimental condition (B1) and the post-experimental condition (B2) measures on Percentage Time Alpha in z-Scores for the "advanced" TM group (A2)

	A2B1	A2B2
Mean	-12.3	2.64
Base	3.537*	ns

DF = 3,31 for all comparisons

TABLE 25(a)

Means and standard deviations for the experimental condition and the post-experimental condition measures on Percentage Time Beta in z-Scores for the "successful" alpha feedback group and the "advanced" TM group

	<u>"Successful"</u> Alpha Feedback Group		<u>"Advanced"</u> TM Group	
	Exp.	Post-Exp.	Exp.	Post-Exp.
Mean	-8.86	-4.87	3.023	-.49
Standard Deviation	20.21	13.71	5.630	2.259
Number in Sample	10	10	10	10

TABLE 25(b)

Analysis of variance summary table for the experimental condition and the post-experimental condition measures on Percentage Time Beta in z-Scores for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	661.4	661.4	2.229
Error	18	5340	296.7	
<u>Within Subjects</u>				
B (Exp. Condition/ Post-Exp. Condition)	1	.5689	.5689	.0029
A x B	1	140.7	140.7	7.095*
Error	18	357	19.84	

TABLE 25(c)

Simple main effects summary table for the experimental condition (B1) and the post-experimental condition (B2) measures on Percentage Time Beta in z-Scores for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	706.1	706.1	4.462*
A at B2	1	95.97	95.97	.6064
Error	36	5597	158.3	
B at A1	1	79.60	79.60	4.013*
B at A2	1	61.71	61.71	3.111
Error	36	714.1	19.84	

TABLE 25(d)

Tukey HSD comparisons* for the means of the experimental condition (B1) and the post-experimental condition (B2) measures on Percentage Time Beta in z-Scores for the "successful" alpha feedback group (A1)

	A1B1	A1B2
Mean	-8.86	-4.87
Base	6.290**	3.457*

DF = 3,36 for all comparisons

TABLE 26(a)

Means and standard deviations for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Heart-Rate for the "successful" alpha feedback group and the "advanced" TM group

	"Successful" Alpha Feedback Group			"Advanced" TM Group		
	Pre-E.	Exp.	Post-E.	Pre-E.	Exp.	Post-E.
Mean	73.75	72.61	70.57	76.98	74.78	73.81
Standard Deviation	6.365	6.936	5.784	8.378	7.934	7.422
Number in Sample	10	10	10	10	10	10

TABLE 26(b)

Analysis of variance summary table for the pre-experimental condition, the experimental condition and the post-experimental condition measures on Heart-Rate for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	124.3	124.3	.8528
Error	18	2624	145.8	
<u>Within Subjects</u>				
B (Pre-Exp., Exp. and Post-Exp. Conditions)	2	100.8	50.41	10.77**
A x B	2	3.906	1.953	.4174
Error	36	168.4	4.679	

TABLE 26(c)

Simple main effects summary table for the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Heart-Rate for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	52.14	52.14	1.008
A at B2	1	23.52	23.52	.4547
A at B3	1	52.5	52.5	1.015
Error	54	2793	51.72	
B at A1	2	51.88	25.94	5.534**
B at A2	2	52.75	26.38	5.637**
Error	48	224.6	4.679	

TABLE 26(d)

Tukey HSD comparisons* for the means of the pre-experimental condition (B1), the experimental condition (B2) and the post-experimental condition (B3) measures on Heart-Rate for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

	A1B1	A1B2	A1B3
Mean	73.73	72.61	70.57
A1B1	-	1.667	4.649**
A1B2		-	2.982
A1B3			-

* DF = 3,36 for all comparisons.

	A2B1	A2B2	A2B3
Mean	76.98	74.78	73.81
A1B1	-	3.216	4.634**
A1B2		-	1.418
A1B3			-

* DF = 3,36 for all comparisons.

TABLE 27(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group and the "advanced" TM group

	"Successful" Alpha Feedback Group		"Advanced" TM Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	71.63	75.77	68.41	68.85
Standard Deviation	6.262	6.251	7.565	5.819
Number in Sample	10	10	10	10

TABLE 27(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	257.1	257.1	3.302
Error	18	1401	77.85	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Sessions)	1	52.46	52.46	7.667*
A x B	1	34.18	34.18	5.000*
Error	18	123.2	6.842	

TABLE 27(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Autonomic Balance ($\bar{A}$) for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	51.84	51.84	1.224
A at B2	1	239.4	239.4	5.655*
Error	36	1524	42.34	
B at A1	1	85.69	85.69	12.52**
B at A2	1	.9531	.9531	.1393
Error	36	246.3	6.842	

TABLE 28(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Heart Period for the "successful" alpha feedback group and the "advanced" TM group

	"Successful" Alpha Feedback Group		"Advanced" TM Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	45.67	54.76	44.24	47.13
Standard Deviation	13.03	14.27	11.91	8.767
Number in Sample	10	10	10	10

TABLE 28(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Heart Period for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	205.2	205.2	.7355
Error	18	5022	279	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Session)	1	358.8	358.8	21.08**
A x B	1	96.11	96.11	5.648*
Error	18	306.3	17.02	

TABLE 28(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Heart Period for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	10.23	10.23	.0069
A at B2	1	291.1	291.1	1.967
Error	36	5328	148.0	
B at A1	1	413.1	413.1	24.28**
B at A2	1	41.76	41.76	2.454
Error	36	612.7	17.02	

TABLE 29(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Pulse Pressure for the "successful" alpha feedback group and the "advanced" TM group

	"Successful" Alpha Feedback Group		"Advanced" TM Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	54.43	56.51	50.96	44.22
Standard Deviation	10.31	9.755	7.422	8.248
Number in Sample	10	10	10	10

TABLE 29(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Pulse Pressure for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	620.9	620.9	4.418*
Error	18	2530	140.5	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Sessions)	1	54.28	54.28	2.495
A x B	1	194.5	194.5	8.940**
Error	18	391.6	21.75	

TABLE 29(c)

Simple main effects summary table for the pre-experimental condition test-session (B1) and the post-experimental condition test-session (B2) measures on Pulse Pressure for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	60.20	60.20	.7418
A at B2	1	755.2	755.2	9.307**
Error	36	2921	81.15	
B at A1	1	21.63	21.63	.9941
B at A2	1	227.1	227.1	10.44**
Error	36	783.2	21.75	

TABLE 30(a)

Means and standard deviations for the pre-experimental condition test-session and the post-experimental condition test-session measures on Respiration Period for the "successful" alpha feedback group and the "advanced" TM group

	"Successful" Alpha Feedback Group		"Advanced" TM Group	
	Pre-E.	Post-E.	Pre-E.	Post-E.
Mean	58.62	67.98	46.91	52.45
Standard Deviation	29.14	27.27	9.967	21.37
Number in Sample	10	10	10	10

TABLE 30(b)

Analysis of variance summary table for the pre-experimental condition test-session and the post-experimental condition test-session measures on Respiration Period for the "successful" alpha feedback group and the "advanced" TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	1855	1855	1.845
Error	18	18097	1005	
<u>Within Subjects</u>				
B (Pre- and Post-Exp. Test-Sessions)	1	555	555	8.054**
A x B	1	36.48	36.48	.5295
Error	18	1240	68.91	

TABLE 30(c)

Simple main effects summary table for the pre-experimental condition (B1) test-session and the post-experimental condition test-session (B2) measures on Respiration Period for the "successful" alpha feedback group (A1) and the "advanced" TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	685.6	685.6	1.276
A at B2	1	1206	1206	2.245
Error	36	19337	537.1	
B at A1	1	438.0	438.0	6.357*
B at A2	1	153.5	153.5	2.227
Error	36	2481	68.91	

TABLE 31(a)

Means and standard deviations for the pre-training and the post-training scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group and the "regular" novice TM group

	"Successful" Alpha Feedback Group		"Regular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	13.6	11.4	14.33	16.00
Standard Deviation	4.766	5.232	5.394	6.176
Number in Sample	10	10	15	15

TABLE 31(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group and the "regular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	85.33	85.33	1.668
Error	23	1177	51.16	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.1797	.1797	.0192
A x B	1	44.85	44.85	4.788*
Error	23	215.5	9.368	

TABLE 31(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Marlowe-Crowne Social Desirability Scale for the "successful" alpha feedback group (A1) and the "regular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	3.226	3.226	.1066
A at B2	1	127	127	4.20*
Error	46	1392	30.26	
B at A1	1	24.20	24.20	2.583
B at A2	1	20.83	20.83	2.224
Error	23	215.5	9.368	

TABLE 32(a)

Means and standard deviations for the pre-training and the post-training scores on the Taylor Manifest Anxiety Scale for the "successful" alpha feedback group and the "regular" novice TM group

	<u>"Successful"</u> Alpha Feedback Group		<u>"Regular"</u> Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	15.6	13.6	18.73	12.87
Standard Deviation	5.68	6.077	9.4	7.15
Number in Sample	10	10	15	15

TABLE 32(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Taylor Manifest Anxiety Scale for the "successful" alpha feedback group and the "regular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	17.28	17.28	.1900
Error	23	2092	90.94	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	233.3	233.3	11.09**
A x B	1	44.85	44.85	2.132
Error	23	483.9	21.04	

TABLE 32(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Taylor Manifest Anxiety Scale for the "successful" alpha feedback group (A1) and the "regular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	58.91	58.91	1.052
A at B2	1	3.227	3.227	.0576
Error	46	2575	55.99	
B at A1	1	20	20	.9507
B at A2	1	258.1	258.1	12.27**
Error	23	483.9	21.04	

Means and standard deviations for the pre-training and the post-training scores on the EPI (N) for the "successful" alpha feedback group and the "regular" novice TM group

	"Successful" Alpha Feedback Group		"Regular" Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	10.5	8.2	12.07	8.933
Standard Deviation	4.378	3.824	5.483	4.217
Number in Sample	10	10	15	15

TABLE 33(b)

Analysis of variance summary table for the pre-training and the post-training scores on the EPI (N) for the "successful" alpha feedback group and the "regular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	15.87	15.87	.4366
Error	23	831.1	36.35	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	98	98	16.34**
A x B	1	2.084	2.084	.3475
Error	23	137.9	5.996	

TABLE 33(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the EPI (N) for the "successful" alpha feedback group (A1) and the "regular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	14.73	14.73	.6955
A at B2	1	3.227	3.227	.1524
Error	46	974	21.17	
B at A1	1	26.45	26.45	4.411*
B at A2	1	73.63	73.63	12.28**
Error	23	137.9	5.996	

Means and standard deviations for the pre-training and the post-training scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "successful" alpha feedback group and the "regular" novice TM group

	<u>"Successful"</u> Alpha Feedback Group		<u>"Regular"</u> Novice TM Group	
	Pre- Training	Post- Training	Pre- Training	Post- Training
Mean	.553	.557	.616	.238
Standard Deviation	.5148	.5049	.3859	.4577
Number in Sample	10	10	15	15

TABLE 34(b)

Analysis of variance summary table for the pre-training and the post-training scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "successful" alpha feedback group and the "regular" novice TM group

Source	DF	SS	MS	F Ratio
<u>Between Subjects</u>				
A (Experimental Group)	1	.1966	.1966	.5984
Error	23	7.556	.3285	
<u>Within Subjects</u>				
B (Pre- and Post- Training Testings)	1	.6339	.6339	6.809*
A x B	1	.4378	.4378	4.702*
Error	23	2.141	.0931	

TABLE 34(c)

Simple main effects summary table for the pre-training (B1) and the post-training (B2) scores on the Repertory Grid - Construct Four (Empathic/Non-Empathic) for the "successful" alpha feedback group (A1) and the "regular" novice TM group (A2)

Source	DF	SS	MS	F Ratio
A at B1	1	.0238	.0238	.113
A at B2	1	.6106	.6106	2.896
Error	46	9.697	.2108	
B at A1	1	.00008	.00008	.0009
B at A2	1	1.072	1.072	11.51**
Error	23	2.141	.0931	

TABLE 35(a)

Means and standard deviations for the change-scores on alpha, beta, high alpha, low alpha, heart-rate, autonomic balance, reaction-time and short-term memory/perceptual speed for the "successful" alpha feedback group and the "advanced" meditator group.

Variables	"Successful" Alpha Feedback Group		"Advanced" Meditator Group	
	Mean	S.D.	Mean	S.D.
Alpha	2.839	4.840	-12.34	21.76
Beta	-8.861	20.21	3.023	5.630
High Alpha	5.107	9.296	2.267	4.799
Low Alpha	1.371	2.116	-2.569	10.73
Heart-Rate	-1.14	3.641	-2.2	1.865
Autonomic Balance	4.14	1.986	0.44	4.839
Reaction-Time	2.29	5.049	-0.13	5.586
S.T.M./P.S.	0.32	1.705	-0.30	0.598

TABLE 35(b)

Hotelling's T-Square Test for the significance of overall differences between the "successful" alpha feedback group and the "advanced" meditator group on the change-scores on alpha, beta, high alpha, low alpha, heart-rate, autonomic balance, reaction-time and short-term memory/perceptual speed

DF	TSQ	F Ratio
8, 11	39,05	2,983*

TABLE 36(a)

Means and standard deviations for the change-scores on alpha, beta and autonomic balance for the "successful" alpha feedback group and the "advanced" meditator group

Variables	"Successful" Alpha Feedback Group		"Advanced" Meditator Group	
	Mean	S.D.	Mean	S.D.
Alpha	2.839	4.840	-12.34	21.76
Beta	-8.861	20.21	3.023	5.630
Autonomic Balance	4.14	1.986	0.44	4.839

TABLE 36(b)

Hotelling's T-Square Test for the significance of overall differences between the "successful" alpha feedback group and the "advanced" meditator group on the change-scores on alpha, beta and autonomic balance

DF	TSQ	F Ratio
3, 16	10,88	3,243*

TABLE 37(a)

Means and standard deviations for the change-scores on "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activity" for the "successful" alpha feedback group and the "regular" novice meditator group

Variables	"Successful" Alpha Feedback Group		"Regular" Novice Meditator Group	
	Mean	S.D.	Mean	S.D.
"Suggestibility"	-1.4	1.430	-0.133	4.103
"Need for Approval"	-2.2	2.658	1.667	5.122
"Anxiety"	-2.0	3.887	-5.867	7.708
"Neuroticism"	-2.3	3.529	-3.2	3.509
"Extraversion"	-0.8	5.514	2.267	3.195
"Empathy"	.004	0.167	-0.378	0.537
"Ability to concentrate"	.048	0.243	-0.291	0.492
"Apathy"	0.319	0.395	0.009	0.647
"Activity"	0.239	0.342	0.0061	0.416

TABLE 37(b)

Hotelling's T-Square Test for the significance of overall differences between the "successful" alpha feedback group and the "regular" novice meditator group on the change-score on "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activity" for the "successful" alpha feedback group and the "regular" novice meditator group

DF	TSQ	F Ratio
9, 15	26,96	1,953

TABLE 38

Stepwise Multiple Linear Regression of the change-scores on alpha, beta, high alpha, low alpha, heart-rate, autonomic balance, reaction-time and short-term memory/perceptual speed for the "successful" alpha feedback group and the "advanced" meditator group

Variable Added	Cumulative Variance of subjects over groups accounted for - Multiple RSQR
Autonomic Balance	21.75%
Alpha	31.19%
High Alpha	40.21%
Heart-Rate	51.32%
Low Alpha	59.48%
Reaction-Time	62.29%
Beta	66.91%
S.T.M./P.S.	68.45%

TABLE 39

Stepwise Multiple Linear Regression of the change-scores on "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "ideal-self" and construed "sensitivity" for the "successful" alpha feedback group and the "regular" novice meditator group

Variable Added	Cumulative Variance of subjects over groups accounted for - Multiple RSQR
"Need for approval"	17.23%
"Ability to concentrate"	28.16%
"Extraversion"	40.61%
"Sensitivity"	49.51%
"Anxiety"	56.92%
"Suggestibility"	57.87%
"Ideal-Self"	58.95%
"Neuroticism"	59.42%
"Empathy"	59.48%

TABLE 40

Means and standard deviations for the scores on the Phenomenological Repertory Grid Constructs for the "successful" alpha feedback group (as defined by "the experimenter's rating" criterion) and the "advanced" TM group

Construct Number	Alpha Feedback Group (n=11)		"Advanced" TM Group (n=8)		F Ratio (DF = 1, 17)
	Mean	SD	Mean	SD	
1	.5455 *	.5025	.3488	.3477	.9035
2	-.364	.6280	.1600	.4274	4.134
3	.0436	.6397	.2288	.5186	.4516
4	-.588 *	.3823	-.233	.4654	3.346
5	-.631 *	.3197	-.330	.1642	5.889 *
6	-.662 *	.3156	-.120	.5500	7.423 *
7	-.704 *	.3811	-.371	.4820	2.825
8	.4245	.5323	.1600	.4875	1.225
9	.4055	.5301	.0163	.3566	3.223
10	-.585 *	.3020	-.438 *	.3739	.9118
11	.5618 *	.4763	.3725	.3309	.9298
12	-.243	.6808	.4675	.2197	.7999
13	.3782	.5511	.4313	.2980	.0606
14	-.054	.6072	.2188	.5677	.9830
15	-.353	.6685	-.376	.3984	.0078
16	.5582 *	.5659	.4450	.3085	.2607
17	.1602	.6931	-.508	.3079	6.575 *
18	-.418	.6884	-.481	.2514	.0695
19	.6227 *	.4294	.1425	.5575	4.517 *
20	.3291	.7317	.4213	.3195	.1102
21	-.531 *	.5582	-.410	.2448	.3256
22	.5282	.5787	.3538	.4214	.5217
24	.7236 *	.3457	.3875	.3542	4.291
25	.7136 *	.3311	.4163 *	.1975	5.086 *
26	.6491 *	.5152	.3063	.3711	2.558
27	.0718	.7141	.1888	.4725	.1616
28	.5618 *	.4774	.4138	.3819	.5231
29	.0773	.8088	-.136	.3524	.4844
30	.7528 **	.2525	.4575 *	.3092	5.448 *
31	-.224	.7983	-.214	.3596	.0011
32	-.643 *	.5125	-.035	.5602	6.029 *
33	-.345	.7451	-.525	.3620	.3963
34	-.734 **	.2116	-.460 **	.2801	5.914 *
35	.3245	.7573	-.039	.5194	1.363
36	-.456	.5932	.1125	.5393	4.587 *

The significance levels shown within the two "Means" columns (i.e., not within the F Ratio column) indicate the level of confidence with which it is assumed that a given group's means score on a particular construct is significantly different from 0.

8.2 Summary of Results:

Feedback-associated alpha enhancement and Transcendental Meditation will not be compared in the present section over all the variables examined in the study but merely on those variables that were shown in previous sections (see sections 6.2 and 7.2) to index one or both of the practices (see section 1.3).

8.2.1 Summary of EEG Results: The "successful" alpha feedback group and the "advanced" meditator group produced significantly different changes with respect to occipital alpha abundance (i.e., Percentage Time Alpha in z-scores) over the short-term experimental sessions ($P < .05$). That is, the groups diverged significantly in terms of alpha from the pre-experimental rest condition (on which they were, by convention, equal) to the experimental condition ($P < .05$) as a result of a strong trend indicative of an increase on the part of the "successful" alpha feedback group and a significant decrease on the part of the "advanced" meditator group ($P < .05$). As a result of a subsidence of these divergent EEG trends on cessation of the experimental condition, no differences were found between the two groups over the post-experimental rest condition.

A significant difference also emerged between the two groups with respect to their changes in occipital beta abundance over the short-term experimental sessions ($P < .05$). Once again, the groups were found to have diverged significantly from the pre-experimental rest condition base to the experimental condition ($P < .05$) as a result of a strong trend indicative of an increase on the part of the "advanced" meditator group and a significant decrease on the part of the "successful" alpha feedback group ($P < .01$). On cessation of the experimental condition, these divergent EEG trends dissipated and no differences were found between the two groups over the post-experimental rest condition.

Since short-term changes within the High Alpha and Low Alpha frequency bands were not found to index either of the two practices (see sections 6.2.1 and 7.2.1), no attempt will be made here at comparison over these two "non-index" variables.

To summarise: Feedback-associated alpha enhancement, as practised by a group of "successful" alpha feedback proponents, was found to be accompanied by significantly more occipital EEG alpha and less beta than was the practice

of Transcendental/

of Transcendental Meditation, as performed by a group of teachers of the technique.

8.2.2 Summary of Heart-Rate Results: Since neither feedback-associated alpha enhancement nor Transcendental Meditation were found to be associated with (short-term) changes in heart-rate (see sections 6.2.2 and 7.2.2 respectively), the two practices were not compared on this "non-index" variable (see section 1.3).

8.2.3 Summary of Autonomic Balance Results: The "successful" alpha feedback group and the "advanced" meditator group produced significantly different changes in autonomic balance from the pre- to the post-experimental condition tests ($P < .05$). Whilst there was no difference between the two groups over the pre-experimental condition test, a significant difference was obtained over the post-experimental condition test ($P < .05$). This was due largely to the "successful" alpha feedback group, but not the "advanced" meditator group, having increased significantly on $\bar{A}$ across the two test-sessions ($P < .01$). That is, the "successful" alpha feedback group moved significantly in a parasympathetic direction whilst the "advanced" meditator group failed to show any change.

The two groups were also compared with respect to their short-term changes on 3 of the 7 physiological parameters that contribute toward $\bar{A}$. These were the 3 physiological variables that had previously been shown to change significantly as a function of one or both of the practices - Heart Period, Respiration Period (see section 6.2.3) and Pulse Pressure (see section 7.2.3). The interspacing of the 20-minute experimental condition between autonomic balance tests for the "successful" alpha feedback group was found to be associated with a significant lengthening of both Heart and Respiration Periods ($P < .01$ and $P < .05$ respectively). For the "advanced" meditator group on the other hand, the interspacing of the experimental condition was found only to be accompanied by a significant lowering of Pulse Pressure ($P < .01$). The changes obtained by the two groups on the measures for Heart Period and Pulse Pressure were significantly different ($P < .05$ and $P < .01$ respectively).

To summarise: Feedback-associated alpha enhancement and Transcendental Meditation were found to be accompanied by significantly different changes in autonomic balance; that is, feedback-associated alpha enhancement was

found to/

found to be followed by a significant parasympathetic autonomic balance shift whilst no such effect was found to follow Transcendental Meditation.

8.2.4 Summary of Reaction-Time Results: Since neither feedback-associated alpha enhancement nor Transcendental Meditation were found to be associated with subsequent (short-term) changes in reaction-time performance (see sections 6.2.4 and 7.2.4), the two practices were not compared on this "non-index" variable.

8.2.5 Summary of Short-Term Memory/Perceptual Speed Results: Since neither of the two practices were found to be associated with subsequent (short-term) changes in short-term memory/perceptual speed performance (see sections 6.2.5 and 7.2.5), they were not compared on this "non-index" variable.

8.2.6 Summary of Psychological Test Results: Nine of the psychological dimensions examined in the present study were found to have changed significantly as a function of the longitudinal practice of one or both of the techniques under investigation - "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activity". ("Hypnotic susceptibility" also changed significantly but this variable was limited to the feedback investigation.) The "successful" alpha feedback group and the "regular" novice meditator group were thus compared with respect to their long-term changes on these 9 psychological variables.

The "successful" alpha feedback group and the "regular" novice meditator group produced significantly different changes with respect to "need for approval" ($P < .05$). That is, as a result of a strong trend indicative of a decrease on the part of the "successful" alpha feedback group and a strong trend indicative of an increase on the part of the "regular" novice meditator group, a pre-training insignificant difference between the two groups on "need for approval" reached significance at post-training ($P < .05$).

The two groups were also found to have produced significantly different changes with respect to construed "empathy" ($P < .05$). That is, whilst the "regular" novice meditator group decreased significantly in terms of construed "empathy" from pre- to post-training ($P < .01$), the "successful" alpha feedback group showed no change.

The two/

The two groups as a whole decreased significantly with respect to "anxiety" ($P < .01$). However, this significant effect was largely the result of a significant decrease on the part of the "regular" novice meditator group ($P < .01$) rather than the insignificant decrease on the part of the "successful" alpha feedback group.

The two groups were found to have produced similar significant changes with respect to "neuroticism". That is, both the "successful" alpha feedback group and the "regular" novice meditator group decreased significantly with respect to "neuroticism" from pre- to post-training ($P < .05$ and $P < .01$ respectively).

Finally, no significant differences emerged between the two groups with respect to their changes on "suggestibility", "extraversion", construed "ability to concentrate", construed "apathy" and construed "activity". There was also no evidence for the two groups as a whole having changed significantly over these variables. (There were trends indicative of differences between the two groups with respect to their changes on "extraversion" and construed "ability to concentrate".)

Thus, significant differences emerged between the groups practising feedback-associated alpha enhancement and Transcendental Meditation on only two of the nine psychological variables over which they were compared - changes in "need for approval" and changes in construed "empathy".

8.2.7 Summary of Hotelling's T-Square Analyses: The "successful" alpha feedback group and the "advanced" meditator group were compared simultaneously on all 8 short-term variables - alpha, beta, high alpha, low alpha, heart-rate, autonomic balance, reaction-time and short-term memory/perceptual speed - and a significant overall difference was obtained between the two groups ($P < .05$).

The "successful" alpha feedback group and the "advanced" meditator group were also compared simultaneously on the 3 short-term variables that had been previously shown to index one or both of the practices - alpha, beta, and autonomic balance. Once again, a significant overall difference emerged between the two groups ($P < .05$).

The "successful" alpha feedback group and the "regular" novice meditator

group/

group were compared simultaneously on the 9 long-term psychological variables that had been previously shown to change as a function of one or both of the practices - "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activity". No overall significant differences emerged between the two groups with respect to their long-term changes over these 9 psychological variables.

8.2.8 Summary of Stepwise Multiple Linear Regression Analyses: The order of importance of the 8 short-term variables for distinguishing between the "successful" alpha feedback group and the "advanced" meditator group was determined by means of a Stepwise Multiple Linear Regression. The order of importance that emerged was as follows: autonomic balance, alpha, high alpha, heart-rate, low alpha, reaction-time, beta and short-term memory/perceptual speed.

A similar analysis was carried out in order to determine the order of importance of the 9 most important long-term psychological test variables for distinguishing between the "successful" alpha feedback group and the "regular" novice meditator group. The order of importance that emerged was as follows: "need for approval", construed "ability to concentrate", "extraversion", construed "sensitivity", "anxiety", "suggestibility", construed "ideal-self", "neuroticism" and construed "empathy".

8.2.9 Summary of Phenomenological Repertory Grid Results: The "successful" alpha feedback group (as defined by "the experimenter's rating" criterion of "success" - see section 5.6.1), as opposed to the "advanced" meditator group, construed their practice to be significantly less associated with "time-slowness" ($P < .05$), more associated with "time-speeding" ($P < .05$), more associated with "floating experiences" ($P < .05$), more associated with "high alpha levels" ($P < .05$), more "anxiety-reducing" ($P < .05$), less "anxiety-evoking" ($P < .05$) and less "unpleasant" ($P < .05$). In addition to these quantitative differences between the two groups (i.e., although both groups construed changes in the same direction, the magnitude of the changes were significantly different), significant qualitative differences were obtained on another two constructs. The "successful" alpha feedback group construed their practice to be accompanied by more "thoughts" whilst the "advanced" meditator group construed their practice to be accompanied by less "thoughts" ($P < .05$). The alpha feedback group construed their practice to be accompanied by a "loss of consciousness"

whilst/

whilst the meditators construed their practice to be accompanied by a change in the opposite direction ($P < .05$). It should be noted, however, that these qualitative differences were obtained on "non-index" variables; that is, on variables that were found not to significantly index either of the two practices.

8.3 Discussion

The sixth and major aim of the present study was to examine the relationship between feedback-associated alpha enhancement and Transcendental Meditation by means of a systematic comparative examination of some of their supposed concomitants. The comparative investigation involved two separate studies - a short-term physiological and behavioural study and a longitudinal psychological study.

Over the short-term, feedback-associated alpha enhancement, as practised by a group of pre-selected "successful" alpha feedback subjects, was compared with Transcendental Meditation, as practised by an "advanced" group of subjects - all teachers of the technique. The variables over which the two practices were compared were restricted to those that had been shown previously (in sections 6 and 7) to index significantly at least one of the practices. Consequently, they were not compared across all the short-term variables examined in the present study - high alpha, low alpha, heart-rate, reaction-time and short-term memory/perceptual speed had all been found to be unaffected by either practice. On the other hand, "successful" feedback-associated alpha enhancement had been shown to be significantly accompanied by changes in occipital alpha abundance and beta abundance and by a subsequent significant shift in autonomic balance (see sections 6.2.1 and 6.2.3). Transcendental Meditation had similarly been found to be accompanied by a significant alteration in alpha abundance and by a strong trend indicative of an alteration in beta abundance (see section 7.2.1). The two practices were thus compared over these three "relevant" variables (see section 1.3) - alpha, beta and autonomic balance.

The two groups were found to have produced significantly different changes on each of the three "relevant" or "index" short-term variables. Feedback-associated alpha enhancement was found to be accompanied by significantly more occipital EEG alpha and less beta than was the practice of Transcendental Meditation. In addition, it was found to be followed by a significant

parasympathetic/

parasympathetic shift in autonomic balance whilst no such effect was found to follow Transcendental Meditation. It should also be emphasised that the alpha and beta EEG differences were only found during the actual experimental conditions (i.e., when the groups were practising their respective techniques) and not during any of the resting control conditions and that the differences with respect to autonomic balance only emerged after the groups had practised their respective techniques (and not before). The two groups were then compared simultaneously with respect to their changes on these three "relevant" variables and, once again, a significant overall difference emerged between the two groups.

It was recognised that the procedure of limiting the comparative examination to criterion "relevant" variables may have resulted in the exclusion from the analysis of "irrelevant" variables that might nevertheless have discriminated between the two practices. An analysis was therefore carried out to determine the order of importance of all eight short-term variables in discriminating between feedback-associated alpha enhancement and Transcendental Meditation. The results, in fact, partially confirmed the above suspicion. The order of importance that emerged was - autonomic balance, alpha, high alpha, heart-rate, low alpha, reaction-time, beta and short-term memory/perceptual speed. Such "irrelevant" variables as low alpha and heart-rate proved to be far more important discriminating variables than the "relevant" variable, beta.

The strategy of limiting the comparative examination to variables that had been shown to index at least one of the two practices was adopted in order to avoid the possibility of significant differences on "relevant" variables being swamped by insignificant effects on "irrelevant" variables (see section 1.3). For example, should sufficient "irrelevant" data be added to "relevant" EEG, REM and EMG data in a statistical analysis of the relationship between stage four sleep and stage one REM sleep, it would be possible to obtain no overall significant difference between the two states. It was nevertheless thought to be of interest to determine whether a significant overall difference would still emerge between the two practices if they were simultaneously compared over all eight short-term variables (i.e., both "relevant" and "irrelevant" variables). Once again, a significant overall difference emerged between the two practices.

The findings of the short-term comparative study appear to provide convincing support for the conclusion that feedback-associated alpha enhancement

(as practised/

(as practised by a group of "successful" subjects) and Transcendental Meditation (as practised by a group of teachers of the technique) have important and significant distinguishing parameters. These differences point toward the practices being accompanied by significantly different psychophysiological conditions. As previously stated (see section 1.3), it is recognised that the strategy of conceptualising these psychophysiological conditions in terms of "states of consciousness" is of debatable usefulness. Nevertheless, in terms of the operational definition for a given state of consciousness adopted by the present study (see section 1.3) - as a hypothetical construct which may be indexed, albeit in an imperfect way, by relevant data drawn from many levels of analysis and derived by different methodological operations - the data appear to be consistent with the conclusion that the practices of feedback-associated alpha enhancement and Transcendental Meditation are associated with significantly different hypothetical altered states of consciousness. That is, the simultaneous "relevant" data (and even the "irrelevant" data) obtained from a number of different levels of analysis and from a number of different methodological operations do not appear to converge upon a single hypothetical state (Stoyva & Kamiya, 1968; Stoyva, 1970). The question of whether the obtained distinction between the two hypothetical altered states is of a qualitative or merely a quantitative nature depends largely upon meta-theoretical issues relating to one's view of "consciousness". For example, should one, like Fischer (1971), conceptualise states of consciousness to range along a continuum of arousal from the ergotropic states to the trophotropic Yoga Somadhi, then it would not even be meaningful to speak in terms of qualitative distinctions - all distinctions would, by definition, have to be quantitative. Since a consideration of these metatheoretical issues is beyond the scope of the present study, no conclusions will be offered concerning whether the obtained differences between the two hypothetical altered states is qualitative or quantitative.

The present conclusion - that the two practices are accompanied by significantly distinct hypothetical states - may be seen to be at variance with the views expressed by the majority of writers in the field (Nideffer, 1973; Stoyva, 1970; Kamiya, 1968, 1969; Mulholland, 1968; Maslow, 1969; Hilgard, 1969; Hart, 1967; Lynch & Paskewitz, 1971; Davidson & Krippner, 1971; Gaarder, 1971; Black, 1971, 1972; Ornstein, 1972; Shapiro & Schwartz, 1972 - see section 4). The conclusion was arrived at not so much on the basis of contradictory data (to the previous writers) but rather as a result of the employment of a more sophisticated kind of research methodology (see

section 4.3)). That is, unlike the majority of previous writers, (1) the states were not only compared over one or two variables but simultaneously on a number of variables in a multidisciplinary comparative experiment, and (2) the two states were not compared on data derived by different researchers and with different methodologies but on data obtained by the same experimenter employing constant experimental techniques across the two practices. No previously published study had attempted a systematic comparative experimental investigation into the relationship between the two practices.

The second part of the comparative study involved a longitudinal investigation into the psychological correlates of the two practices.. The pre- and post-training scores of a group of "successful" alpha feedback subjects on a number of psychological variables were compared with those of a "regular" novice meditator group. As in the case of the short-term comparative experiment, the two practices were not compared over all the psychological variables examined in the study but merely on those that had previously been shown to change (or to index) as a function of at least one of the two practices (see section 6.2.6 & 7.2.6). Feedback-associated alpha enhancement and Transcendental Meditation were consequently not compared on the following psychological dimensions: construed "tenseness", construed "ideal-self", construed "frustration-tolerance", construed "happiness", construed "warmth", construed "withdrawal", construed "creativity", construed "optimism", construed "confidence" and construed "sensitivity". On the other hand, "successful" feedback-associated alpha enhancement had been found to be accompanied by changes in "suggestibility", (also in "hypnotic susceptibility" but this variable was not included in the comparative examination), "need for approval", "neuroticism", construed "apathy" and construed "activeness" (see section 6.2.6). "Regular" Transcendental Meditation practice had been shown to be associated with changes in "need for approval", "neuroticism", "anxiety", "extraversion", construed "empathy" and construed "ability to concentrate". The longitudinal practice of the two techniques was thus compared on the following nine "relevant" psychological variables (i.e., criterion indices - see section 1.3) - "suggestibility", "need for approval", "anxiety", "neuroticism", "extraversion", construed "empathy", construed "ability to concentrate", construed "apathy" and construed "activeness".

The results indicated that the groups produced significantly different changes on only two of these nine psychological variables - on "need for approval" and on construed "empathy". However, in view of the previously

mentioned/

mentioned problem associated with the construct "empathic/non-empathic" (see section 7.3), the finding with regard to this variable is questionable. Generally, the longitudinal practice of both techniques tended to be accompanied by similar reductions in "negative" psychological characteristics and increases in "positive" psychological characteristics. The "successful" alpha feedback group and the "regular" novice meditator group were then compared simultaneously with respect to their long-term changes on these nine "relevant" psychological variables. The result - that there was no overall difference between the two groups on the variables - strongly supported the conclusion that the regular long-term practice of feedback-associated alpha enhancement and Transcendental Meditation are accompanied by similar measurable psychological changes.

As in the case of the short-term comparative experiment, it was recognised that the procedure of limiting the comparative examination to criterion "relevant" variables may have resulted in the exclusion from the analysis of "irrelevant" variables that might nevertheless have discriminated between the two practices. An analysis was therefore carried out in order to determine the order of importance of the nine most important (from a discrimination point of view) psychological variables in discriminating over the long-term between the two practices. The order of importance that was obtained was as follows: "need for approval", construed "ability to concentrate", "extraversion", construed "sensitivity", "anxiety", "suggestibility", construed "ideal-self", "neuroticism" and construed "empathy". Changes in "need for approval" turned out to be not only perhaps the only psychological variable over which the two groups differed significantly (in view of the questionable status of the construed "empathy" variable), but also emerged as the most important variable for distinguishing between the two groups.

The above findings seem to indicate that although the practices of feedback-associated alpha enhancement and Transcendental Meditation were found to be accompanied by largely similar psychological changes, the role played by factors associated with "need for approval" in contributing toward these changes might have been different for the two practices. The significant difference found between the two groups with respect to their changes in "need for approval" - with the alpha feedback subjects decreasing and the meditators increasing - underlines previously discussed conclusions concerning the role of factors associated with "need for approval" in contributing toward psychological changes. That is, whilst it was concluded

that there/

that there was no evidence to suggest that changes in "need for approval" might have contributed toward the alpha feedback-associated "positive" psychological changes (see section 6.3), it was concluded that limited evidence pointed toward increases in "need for approval" as having contributed toward the meditation-associated "positive" psychological changes (see section 7.3). A possible reason for the apparently different role played by these factors in the two practices is the following. The meditation subjects were taught their techniques within a philosophical and social framework almost ideally structured for the purposeful manipulation of the "attitudes", "expectancies" and "motivations" etc. of suitable (i.e., predisposed) subjects. The enhanced "need for approval" shown by these subjects may therefore have been a reflection of the influence of these "Transcendental Meditation-associated social pressures" (see sections 7.3 & 3.2.4). The alpha feedback subjects on the other hand were not knowingly exposed to any purposefully manipulated social pressures. Those to which they might have been exposed were of a covert nature and probably highly variable across subjects. Social factors, such as perceived "demand characteristics" etc., appeared therefore to have no systematic effect in raising these subjects' "need for approval".

The practices of feedback-associated alpha enhancement and Transcendental Meditation were also compared over the short-term on a subjective level. The scores of a group of "advanced" meditators on the constructs of the Phenomenological Repertory Grid (see Appendix K) were compared with those of a "successful" alpha feedback group. This "successful" group, it should be noted, were constituted according to a different criterion of "success" to that used throughout the rest of the study (i.e., according to "the experimenter's rating criterion" - see section 5.6.1). It was selected because it was directly related to the "strength" of subjects' alpha-feedback associated subjective experiences. The correlation between the ranking of the subjects according to this criterion and according to the criterion used elsewhere (i.e., "the alpha z-score change rating criterion") was fortunately acceptably high ($r = 0,7158$) (see section 5.6.1 - Table 5).

As for the two previous comparative experiments, the practices were only compared on those variables that had been shown previously (see sections 6.2.7 & 7.2.7) to significantly index at least one of the practices. They were consequently compared on 17 of the 35 constructs - constructs one, four, five, six, seven, ten, eleven, sixteen, nineteen, twenty-one, twenty-four, twenty-five, twenty-six, twenty-eight, thirty, thirty-two and thirty-

four. Significant differences were obtained between the two groups on 7 of these 17 "relevant" (i.e., criterion index) constructs. In each instance, the significant difference was quantitative; that is, both groups construed their practices to be accompanied by similar changes but the magnitude of these construed changes was significantly different. In each case, it was the "successful" alpha feedback group that construed their practice to be accompanied by the more extreme changes. Thus, for example, although both groups construed their practices to be accompanied by "time-speeding" (i.e., they experienced time to pass very quickly. A 20-minute experimental session was frequently perceived to be as short as 5 minutes.), the alpha feedback group indicated a significantly stronger awareness of the effect. The alpha feedback group also construed their practice to be significantly less "anxiety-evoking", more "anxiety-reducing", less "unpleasant" and less associated with "time-slowness", more associated with "high alpha levels" and more associated with "floating sensations".

The obtained distinctions between the two groups with respect to the construed subjective concomitants of their respective practices are unfortunately open to at least two contradictory interpretations. The most obvious is that the distinctions reflect differences between the subjective states associated with the two practices. Alternatively, the findings are also consistent with the view that the two groups might simply have translated essentially the same phenomenal experience into somewhat different verbal form. For example, what may have been considered a profound effect by the relatively inexperienced alpha feedback subjects, may have been thought of as relatively "common-place" by the more experienced "advanced" meditators. A far stronger phenomenal experience may therefore have been required to have elicited the same verbal response from the meditators. The finding that it was the alpha feedback subjects, rather than the meditators, who consistently scored more extreme on the constructs, is consistent with this interpretation.

In view of the interpretation problems associated with the subjective data, no conclusions may validly be derived from them concerning the relationship between the two hypothetical altered states of consciousness. This finding is consistent with the previously expressed view of the author concerning the low reliability and validity of subjective data for the indexing of altered states of consciousness (see section 4.1).

To summarise: Feedback-associated alpha enhancement and Transcendental Meditation were found to have important and significant distinguishing

short-term parameters. It was concluded that these data were consistent with the view that the two practices are accompanied by distinct hypothetical altered states of consciousness. The psychological correlates of the regular long-term practice of the two techniques were also compared and they were found to be accompanied by largely similar psychological changes - "positive" psychological characteristics tended to be enhanced whilst "negative" psychological characteristics tended to be reduced. There was evidence, however, to suggest that some of the underlying mechanisms responsible for these similar psychological changes were not the same. Finally, problems of interpretation rendered inconclusive subjective data on the relationship between the two hypothetical altered states of consciousness.

9.0 CONCLUSION

9.1 Conclusions bearing on the Alpha Feedback Investigation

One of the aims of the present study was to attempt to demonstrate the phenomenon of operant alpha enhancement in accordance with the criteria for acceptability outlined by Katkin and Murray (1968). Their three criteria were thus systematically applied to the experimental design and to the data of the study. On the basis of this application, it was concluded that although the phenomenon had been satisfactorily demonstrated, it appeared to have been operantly-mediated. It was further tentatively suggested that possibly all instances of apparent direct alpha control are, in fact, mediated (possibly unconsciously) via control over oculomotor efferent activity (see section 6.3).

A second major aim of the study was to determine the physiological, behavioural and psychological correlates of feedback training for alpha enhancement. A short-term physiological and behavioural experiment revealed "successful" feedback-associated alpha enhancement to be significantly accompanied by an enhancement in occipital alpha abundance and a reduction in occipital beta abundance. In addition, the practice was found to be followed by a significant parasympathetic shift in autonomic balance. There was also some evidence to suggest that "successful" practice might be associated with a greater ability to relax in an experimental situation, as reflected by faster rates of heart-rate reduction.

A longitudinal psychological experiment revealed that the regular "successful" practice of feedback-associated alpha enhancement was accompanied by reductions in "negative" psychological characteristics and increases in "positive" psychological characteristics. Specifically, "need for approval" and "neuroticism" were found to have decreased whilst subjects tended to construe themselves as more "active" and "involved". There was no evidence to suggest that these "positive" psychological changes may have been due to the effects of factors confounded with "successful" alpha feedback practice - such as increases in "need for approval" or the perceived "demand characteristics" of the experimental situation. It was thus concluded that the regular "successful" practice of feedback-associated alpha enhancement

was associated/

was associated with "desirable" psychological changes.

"Successful" long-term alpha feedback practice was also found to be accompanied by significantly raised "hypnotic susceptibility" - a finding congruent with that of Engstrom, London and Hart (1970a, b) (see section 2.3). In going beyond this earlier research, it was also found that the enhanced "hypnotic susceptibility" was unaccompanied by an increase in "direct" (or waking) "suggestibility". This additional finding (plus other evidence) suggested an alternative mechanism to that proposed by Engstrom, London and Hart for the alpha feedback-associated "hypnotic susceptibility" increase. It was concluded that the practice raises "hypnotic susceptibility", not via its influence upon "suggestibility" per se, but rather via its influence upon subjects' ability to adopt "passive" attentional states" during conditions necessitating relaxation. The implication of this alternative interpretation is that alpha feedback may only be useful for the raising of "hypnotic susceptibility" under conditions of relaxation.

Finally, a short-term examination of the subjective correlates of "successful" feedback-associated alpha enhancement provided data that supported much of the findings of the other experiments.

9.2 Conclusions bearing on the Transcendental Meditation Investigation

A third major aim of the study was to examine the occipital EEG correlates of Transcendental Meditation (see section 1.2). A short-term experiment indicated that meditation (as practised by teachers of the technique) was accompanied by a significant reduction in occipital alpha abundance and by a trend indicative of enhanced occipital beta abundance. These data, it was concluded, are consistent with the hypothesis that Transcendental Meditation may be accompanied by a forward migration of slower EEG activity toward the frontal EEG channels and by an intensification of lower voltage fast activity over the posterior regions. They are unfortunately also not inconsistent with the hypothesis that meditation-associated EEG changes might be indistinguishable from those of light sleep (Otis, 1974). It was thus additionally concluded that, in order to obtain decisive evidence on these two incompatible hypotheses, further similar EEG research into meditation is to be recommended wherein simultaneous EEG data from frontal and central channels are also examined (in addition to occipital EEG data).

A fourth/

A fourth major aim of the study was to examine a number of short-term physiological and behavioural correlates of meditation. The practice was found to be unaccompanied by changes in heart-rate. In addition, it was not found to be associated with a subsequent change in autonomic balance nor with changes in performance on tasks involving reaction-time and short-term memory/perceptual speed. It was concluded that the failure to find a hypometabolic condition after meditation (which does not imply the absence or presence of such a condition during actual meditation) raises some doubt concerning the efficacy of meditation-associated hypometabolism as a mechanism underlying the assumed meditation-associated psychotherapeutic benefits (see section 3.3.4).

A fifth major aim of the study was to explore the psychological concomitants of regular meditation practice and to attempt to determine the role, if any, of factors related to changes in "need for approval" in bringing about measurable psychological changes. "Regular" long-term meditation practice was found to be accompanied by reductions in "negative" psychological characteristics and by increases in "positive" psychological characteristics. Specifically, "anxiety" and "neuroticism" were found to be reduced whilst "extraversion" was found to be increased and subjects tended to construe themselves as better "able to concentrate". These findings were largely in line with those of previous researchers (see section 3.2.4). However, a strong trend indicative of an increase in "need for approval" provided some tentative evidence to suggest that these "positive" psychological changes might not simply have been due to the cumulative effects of regular meditation practice. The increase in "need for approval" may have contributed - either directly by its possible effect on some psychological variables or indirectly via its influence upon a subject's meditation regularity - toward the meditation-associated psychological changes. It was tentatively suggested that the enhanced "need for approval" may have been a reflection of the effects of "Transcendental Meditation-associated social pressures" upon suitably predisposed subjects (see section 3.3.5). On the basis of this suggestion, it was tentatively concluded that should it be desired to raise Transcendental Meditation's assumed psychotherapeutic properties, then more attention should be directed toward the manipulation of these non-time-dependent (or non-cumulative) social factors which appear to contribute crucially (along with the possible cumulative effects of meditation per se) toward the meditation-associated beneficial psychological changes.

9.3 Conclusions bearing on the Comparative Multidisciplinary Investigation

The sixth and major aim of the present study was to investigate the relationship between the hypothetical altered states of consciousness associated with feedback-associated alpha enhancement and Transcendental Meditation by means of a systematic comparative examination of some of their supposed concomitants (see section 1.3).

The two practices were compared in a short-term physiological and behavioural experiment on three variables - alpha and beta abundance and autonomic balance - that had previously been shown to significantly index one or both of the practices. Significant differences emerged between the two practices on each of these three "relevant" variables. "Successful" feedback-associated alpha enhancement was found to be accompanied by more occipital alpha and less occipital beta. In addition, it was found to be followed by a parasympathetic autonomic balance shift whilst no such effect was found to follow Transcendental Meditation. The practices were then compared simultaneously on these three "relevant" variables and a significant overall difference was found. A similar simultaneous comparison on all short-term variables (i.e., also on the "non-indices") also produced a significant overall difference between the two practices. On the basis of these findings, it was concluded that feedback-associated alpha enhancement and Transcendental Meditation have important and significant distinguishing parameters, and that, in terms of the present definition of hypothetical states of consciousness (see section 1.3), the data were consistent with the view that the practices are accompanied by distinct hypothetical altered states of consciousness.

The practices were also compared over the long-term on psychological variables that had been shown previously to alter significantly as a function of at least one of the practices. Groups who practised the two techniques were found to produce very similar psychological changes - "negative" psychological characteristics tended to be reduced whilst "positive" psychological characteristics tended to be enhanced. The only definite significant difference that emerged between the two groups was with respect to their changes in "need for approval" - with the alpha feedback group decreasing and the meditators increasing. This also turned out to be the variable that discriminated best between the two practices. On the basis of this data, it was concluded that although the two practices seemed to be

accompanied by/

accompanied by highly similar measurable psychological changes, some of the mechanisms underlying these changes appeared to be different. In the case of Transcendental Meditation, social factors appeared to play an important role in raising "need for approval" which, in turn, may have contributed crucially toward the obtained psychological changes. For feedback-associated alpha enhancement on the other hand, there was no evidence for social factors having exerted any systematic or measurable effect.

Finally, an attempt was made to compare the short-term subjective concomitants of the two practices. Although some significant differences were obtained, the data were open to contradictory interpretations. As a result, no conclusions could validly be derived from these data concerning the relationship between the two hypothetical altered states of consciousness.

APPENDICES

EEG DATA

ALPHA FEEDBACK GROUP - PERCENTAGE TIME ALPHA

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	9.7	10.7	13.1	7.3	4.3	10.0	8.7	10.0	15.9	12.3	38.3	30.0
2	81.3	83.0	81.8	85.4	53.7	67.7	68.4	84.0	77.4	81.1	72.3	80.3
3	37.4	29.4	28.1	41.2	69.8	58.4	51.3	59.9	54.4	63.8	95.7	67.0
4	39.0	35.5	26.0	31.7	53.3	38.0	74.9	66.6	65.0	64.8	62.7	52.0
5	11.8	9.3	13.6	15.7	19.6	12.0	29.0	22.4	22.0	35.8	5.5	10.4
6	0.0	0.0	0.0	0.0	4.8	2.2	3.7	4.0	3.8	10.0	16.2	7.8
7	28.8	20.5	28.8	23.3	20.2	15.5	39.8	26.2	31.1	24.9	37.2	44.0
8	5.3	6.4	8.5	9.1	16.0	10.0	7.8	3.4	7.9	11.8	12.7	13.0
9	32.8	32.2	33.9	33.1	48.0	63.7	79.3	58.3	68.0	75.0	60.0	72.3
10	10.3	10.4	9.8	12.8	23.2	18.2	29.0	38.8	45.8	34.7	26.7	46.7
11	6.2	6.4	8.4	5.9	5.0	1.7	3.0	4.6	6.0	11.1	0.7	0.0
12	28.9	29.2	17.4	20.7	31.0	32.0	44.2	47.2	36.6	35.0	53.0	52.0
13	54.2	48.7	34.5	43.7	29.8	95.3	94.6	80.2	76.4	77.9	59.9	47.4
14	41.8	24.7	21.6	19.4	66.0	64.0	66.0	31.2	29.5	35.0	74.0	68.0
15	49.4	41.9	37.8	33.3	70.7	67.0	65.4	64.7	63.2	66.0	52.5	60.8
16	0.4	0.3	0.5	0.8	4.2	2.0	9.3	10.4	11.5	12.0	12.0	12.3
17	1.7	0.1	0.7	0.2	1.0	0.7	0.6	00.6	1.2	1.2	0.3	0.0
18	24.4	16.3	26.5	35.1	50.3	36.8	43.8	42.9	48.3	53.9	59.5	47.3
19	24.8	23.7	21.8	20.3	36.4	41.8	35.0	37.0	46.9	40.4	39.2	48.0
20	64.2	60.5	59.3	54.1	96.7	88.0	98.3	98.3	97.3	87.8	73.3	78.3

ALPHA FEEDBACK GROUP - PERCENTAGE TIME BETA

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	24.3	23.8	27.2	26.4	50.3	46.3	38.9	36.3	27.0	30.9	29.6	23.6
2	1.3	1.3	2.5	2.5	0.7	1.7	2.0	1.5	1.9	2.3	2.7	2.7
3	6.1	11.1	13.3	6.5	5.4	6.2	4.1	4.8	7.9	7.6	6.3	10.5
4	7.3	8.9	10.0	6.4	18.7	16.0	10.9	6.1	6.8	7.1	10.0	9.0
5	21.4	17.1	13.9	12.4	16.3	25.4	19.3	19.8	32.0	30.3	29.0	24.7
6	6.9	7.7	11.3	8.9	41.4	40.7	29.8	28.8	21.3	19.7	15.3	37.1
7	3.8	3.0	2.8	4.9	9.3	10.0	9.7	10.7	11.5	9.6	11.8	11.2
8	14.0	14.9	15.3	12.0	30.0	19.3	29.9	26.2	24.3	23.3	18.0	20.0
9	5.2	3.5	2.6	6.2	3.7	6.0	4.0	3.0	4.7	2.3	3.3	0.7
10	8.0	7.1	6.6	8.3	17.5	23.2	7.1	5.8	5.4	7.4	8.7	0.7
11	16.4	16.3	17.9	16.8	20.3	28.7	25.7	25.7	25.2	25.1	31.3	28.3
12	3.4	5.0	4.3	8.2	4.3	5.3	5.3	6.5	5.6	8.3	2.4	4.8
13	1.9	1.6	1.3	3.8	3.0	0.0	1.8	2.1	0.9	1.5	5.0	6.0
14	6.7	6.3	12.3	10.6	1.0	0.0	10.7	12.7	9.3	8.5	1.5	1.7
15	1.7	2.0	1.6	2.8	2.5	4.3	2.4	1.1	2.1	2.2	2.0	3.7
16	26.4	30.4	23.3	24.7	33.5	25.2	27.4	24.0	22.7	18.7	28.3	16.8
17	25.2	17.8	40.7	16.0	29.7	46.2	45.1	39.8	37.6	30.4	49.1	48.6
18	4.8	8.3	7.1	7.1	2.0	5.8	4.3	7.1	3.1	4.3	4.7	3.5
19	4.3	8.0	9.6	11.3	9.8	6.7	8.0	9.2	8.7	11.0	10.0	5.5
20	1.9	3.3	2.1	2.3	1.3	1.0	0.2	0.0	0.7	1.2	2.0	0.0

Each Percentage Time Score in Appendix A represents the mean score obtained over four experimental sessions for a particular 5-minute period (see section 5.3.1)

ALPHA FEEDBACK GROUP - PERCENTAGE TIME HIGH ALPHA

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	1.9	3.0	3.6	1.4	1.9	1.6	2.7	2.6	3.8	3.4	3.3	5.0
2	3.1	8.3	9.8	11.8	1.0	0.0	2.6	3.1	4.3	3.5	1.0	0.0
3	12.4	12.0	9.7	15.6	32.8	39.3	17.3	26.9	24.2	25.9	78.6	39.3
4	10.6	9.1	8.8	8.6	3.7	2.3	18.8	13.2	13.8	12.0	4.3	5.3
5	2.8	3.2	2.2	1.9	0.9	0.9	3.4	2.3	0.6	3.2	0.6	5.8
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	9.9	4.2	7.6	7.1	4.7	4.5	5.0	3.9	3.6	4.8	2.2	4.0
8	1.3	0.6	1.3	0.6	2.7	0.0	0.7	0.7	0.5	1.1	1.0	1.3
9	12.2	11.0	16.5	9.9	7.7	15.0	31.7	28.7	17.3	11.3	22.0	26.7
10	4.1	3.1	3.2	1.4	8.2	3.2	5.9	7.0	9.0	11.7	6.7	6.0
11	1.0	1.1	1.7	1.4	0.0	0.0	0.1	0.2	0.3	1.2	2.0	1.3
12	0.6	0.6	1.8	0.2	3.0	0.0	1.9	0.3	0.9	0.4	0.0	0.0
13	0.0	0.2	1.2	0.4	0.5	0.3	0.4	0.6	0.8	0.8	0.1	0.4
14	11.4	11.4	3.7	6.3	10.4	12.0	14.8	12.5	9.7	11.8	19.0	21.2
15	22.7	19.3	16.1	14.9	17.7	23.0	25.9	25.6	27.3	24.6	14.7	20.7
16	0.2	0.0	0.2	0.3	0.0	0.2	0.6	0.2	0.0	0.4	0.2	0.5
17	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.3	0.0	0.7	2.3	0.0
18	11.8	8.0	11.5	15.0	18.0	21.2	20.0	21.6	21.2	30.6	35.3	31.2
19	3.4	3.8	4.3	4.0	4.5	4.0	0.8	4.1	4.9	3.7	6.8	2.5
20	5.3	2.3	5.3	3.8	2.0	2.0	11.0	5.3	9.3	5.0	1.7	1.0

ALPHA FEEDBACK GROUP - PERCENTAGE TIME LOW ALPHA

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	29.3	21.0	18.9	19.8	12.7	11.3	27.3	24.5	26.0	25.0	7.7	18.7
3	0.5	0.0	0.4	0.5	0.0	1.3	0.6	0.1	0.6	0.2	0.0	0.0
4	0.8	0.8	1.5	1.8	6.7	2.3	9.9	6.6	7.7	6.7	16.0	14.0
5	0.3	0.0	0.0	1.5	0.0	0.0	0.3	0.3	0.4	1.4	0.0	3.6
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.5	1.0	1.3	2.3	0.3	0.0	6.6	2.4	4.3	3.7	6.7	3.0
8	0.0	0.0	0.5	0.4	0.0	0.0	0.2	0.0	0.2	0.6	0.3	0.0
9	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7	0.3	0.7	1.3
10	0.0	0.0	0.3	0.0	0.0	1.0	0.0	0.3	0.1	0.3	0.0	0.0
11	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	2.6	4.3	2.7	3.7	0.7	6.7	3.7	6.3	5.9	7.6	19.3	16.7
13	12.0	22.0	15.4	6.4	28.2	19.1	25.6	30.5	27.7	34.8	16.1	8.4
14	0.0	0.0	0.2	0.4	0.0	0.2	0.2	0.0	0.0	0.7	6.7	1.2
15	0.6	0.3	0.7	1.5	1.2	0.7	1.6	1.0	0.3	1.9	0.5	3.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.6	0.0	0.2
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.1	0.1	0.0	0.0	0.3	0.8	0.1	0.6	1.2	0.3
19	0.1	0.1	0.8	1.7	2.0	1.7	2.0	1.2	4.2	4.1	3.7	6.2
20	11.2	7.2	5.5	12.0	62.3	36.0	53.7	42.2	47.7	30.8	50.0	40.0

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME ALPHA

Time	Rest				Pre- Experimental Rest		Experimental				Post- Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	23.0	18.0	4.0	8.0	17.2	19.7	14.3	11.8	11.8	8.9	34.8	36.0
2	37.0	53.3	40.3	47.0	48.9	43.6	43.4	30.0	57.8	40.6	36.7	39.0
3	33.3	49.3	38.3	48.7	20.5	21.7	20.0	15.5	20.5	22.3	19.5	19.8
4	80.3	83.0	86.0	88.0	56.2	52.3	56.3	51.2	59.0	51.0	42.5	49.8
5	83.7	87.3	90.7	83.0	79.3	83.8	70.7	49.7	29.1	24.8	73.3	77.1
6	86.7	95.0	91.3	92.3	87.3	88.2	76.6	73.3	67.0	60.9	97.9	91.7
7	76.7	76.7	83.7	79.0	43.3	54.0	71.7	66.3	58.0	59.0	59.3	50.7
8	97.0	94.0	94.7	96.0	93.0	93.2	92.4	88.3	87.7	64.8	89.8	91.5
9	58.7	45.7	48.7	58.0	43.4	40.3	36.3	32.4	32.7	30.4	31.7	35.0
10	39.0	32.0	41.7	52.3	63.4	64.1	61.1	67.8	73.1	67.2	71.3	70.3

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME BETA

Time	Rest				Pre- Experimental Rest		Experimental				Post- Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	24.3	21.0	26.7	40.0	19.9	22.6	21.9	19.3	23.0	16.6	18.3	18.3
2	1.7	2.3	3.3	5.0	2.6	3.3	2.8	5.6	2.3	0.7	3.6	3.8
3	9.7	9.7	5.0	2.7	4.8	4.0	5.2	8.3	6.2	7.2	5.2	4.5
4	0.7	0.0	2.7	2.7	5.0	4.2	6.5	6.2	5.7	5.7	4.0	3.7
5	1.0	1.0	2.3	0.3	3.7	2.3	3.7	9.9	13.0	9.0	3.3	2.1
6	1.7	0.3	1.3	0.3	0.4	0.7	0.8	0.9	4.4	2.7	2.6	0.0
7	0.3	0.7	0.0	0.3	3.3	1.3	1.7	1.3	1.7	2.0	1.7	3.3
8	1.0	0.0	0.3	0.0	0.4	0.4	0.0	0.3	0.2	2.0	1.4	0.0
9	4.0	3.7	10.7	8.7	7.2	7.9	8.6	5.7	4.4	4.4	7.2	5.2
10	7.0	6.0	4.0	6.0	1.4	1.2	2.7	2.0	2.3	2.1	1.1	0.0

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME HIGH ALPHA

Time	Rest				Pre- Experimental Rest		Experimental				Post- Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	1.0	0.0	0.0	0.3	0.0	0.0	0.6	0.6	0.1	0.7	0.7	0.8
2	19.3	22.7	18.0	22.0	26.0	24.8	21.6	23.1	30.2	25.3	20.8	24.8
3	0.0	2.7	0.7	1.3	0.0	0.0	0.0	1.5	0.8	2.7	0.3	0.7
4	1.7	5.0	1.3	6.0	1.2	1.0	1.2	1.0	1.3	1.7	1.2	1.2
5	1.3	5.3	8.3	8.7	1.4	1.2	2.3	2.2	0.8	0.6	1.1	1.1
6	5.0	11.3	12.0	8.3	2.5	2.0	5.9	5.8	4.1	5.2	10.1	4.0
7	3.3	1.3	0.0	1.7	5.3	10.7	3.7	11.0	7.3	12.3	7.7	3.0
8	0.7	1.3	2.3	1.0	0.8	1.0	0.7	0.6	0.7	0.6	0.0	0.0
9	12.0	11.3	7.7	14.0	3.1	3.7	3.6	2.9	2.2	5.2	9.5	4.5
10	1.3	3.0	1.0	0.0	1.7	3.1	0.7	2.2	1.2	0.4	0.8	0.6

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME LOW ALPHA

Time	Rest				Pre- Experimental Rest		Experimental				Post- Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.4
2	3.7	0.0	0.3	5.7	0.4	0.6	0.2	0.4	1.2	0.8	0.6	0.7
3	2.7	7.7	1.7	6.7	5.2	5.3	9.2	8.5	8.7	5.3	7.7	5.0
4	16.7	20.7	14.7	15.0	4.8	7.3	2.0	7.0	7.8	4.8	6.5	6.5
5	27.3	12.7	21.7	20.3	16.1	18.6	17.8	9.0	5.6	4.9	16.5	26.6
6	23.3	37.0	23.7	30.0	30.1	31.3	21.1	16.8	17.9	20.7	43.3	43.0
7	34.7	42.3	31.0	36.0	12.3	2.7	3.7	11.0	7.3	12.3	7.7	3.0
8	73.0	60.7	55.3	53.7	57.2	52.9	57.1	57.0	65.1	35.1	70.3	62.6
9	2.3	2.3	0.7	1.0	4.1	4.0	5.8	2.4	2.2	2.1	7.3	4.4
10	1.0	0.3	2.3	0.3	5.7	8.6	5.2	8.0	6.4	10.8	5.7	6.6

NORMALISED EEG DATA (SHORT-TERM BASE)

ALPHA FEEDBACK GROUP - PERCENTAGE TIME ALPHA IN z-SCORES
(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject 1	1	-0.71	0.71	0.38	0.71	2.17	1.28	7.73	5.67
	2	-0.71	0.71	0.79	2.63	1.85	2.29	1.25	2.19
	3	0.71	-0.71	-1.59	-0.52	-1.20	-3.72	3.92	0.36
	4	0.71	-0.71	2.70	1.94	1.79	1.77	1.58	0.59
	5	0.71	-0.71	2.46	1.23	1.15	3.72	-1.92	-1.00
	6	0.71	-0.71	0.11	0.27	0.16	3.54	6.91	2.34
	7	0.71	-0.71	6.60	2.51	3.99	2.12	5.52	7.87
	8	0.71	-0.71	-1.23	-2.26	-1.20	-0.28	-0.00	0.0
	9	-0.71	0.71	2.11	0.22	1.09	1.72	0.37	1.48
	10	0.71	-0.71	5.18	5.12	7.10	3.96	1.70	7.35
	11	0.71	-0.71	-0.15	0.54	1.14	3.32	-1.14	-1.44
	12	-0.71	0.71	17.96	22.20	7.21	4.95	30.41	28.99
	13	-0.71	0.71	0.53	-3.18	-4.15	-3.77	-8.40	-11.61
	14	0.71	-0.71	0.71	-23.90	-25.10	-21.21	6.36	2.12
	15	0.71	-0.71	-1.32	-1.59	-2.16	-1.09	-6.25	-3.08
	16	0.71	-0.71	3.99	4.69	5.40	5.72	5.72	5.91
	17	0.71	-0.71	-1.18	-1.18	1.65	1.65	-2.53	-4.00
	18	0.71	-0.71	0.0	-0.0	0.59	1.08	1.67	0.39
	19	-0.71	0.71	-1.07	-0.55	2.04	0.34	0.0	2.33
	20	0.71	-0.71	0.97	0.97	0.80	-6.74	-3.10	-2.28

ALPHA FEEDBACK GROUP - PERCENTAGE TIME BETA IN z-SCORES
(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject 1	1	0.71	-0.71	-3.32	-4.24	-7.53	-6.15	-6.61	-8.73
	2	-0.71	0.71	1.13	0.42	0.99	1.56	2.12	2.12
	3	-0.71	0.71	-3.00	-1.77	3.71	3.18	0.88	8.31
	4	0.71	-0.71	-3.38	-5.89	-5.53	-5.37	-3.85	-4.37
	5	-0.71	0.71	-0.24	-0.16	1.73	1.47	1.27	0.60
	6	0.71	-0.71	22.75	24.77	39.93	43.17	52.06	7.99
	7	-0.71	0.71	0.10	2.12	3.74	-0.10	4.34	3.13
	8	0.71	-0.71	0.69	0.20	-0.00	-0.18	-0.83	-0.61
	9	-0.71	0.71	-0.52	-1.19	-0.00	-1.57	-0.95	-2.55
	10	-0.71	0.71	-3.29	-3.61	-3.71	-3.21	-2.89	-4.38
	11	-0.71	0.71	0.20	0.20	0.12	0.10	1.14	0.64
	12	-0.71	0.71	0.71	2.12	1.13	4.95	-3.39	0.0
	13	0.71	-0.71	0.14	0.28	-0.28	0.0	1.65	2.12
	14	0.71	-0.71	10.93	13.11	9.41	8.54	0.92	1.14
	15	-0.71	0.71	-0.79	-1.81	-1.02	-0.94	-1.10	0.24
	16	0.71	-0.71	-0.33	-0.91	-1.13	-1.18	-0.18	-2.14
	17	-0.71	0.71	0.61	0.16	-0.00	-0.65	0.96	0.91
	18	-0.71	0.71	0.15	1.19	-0.30	0.15	0.30	-0.15
	19	0.71	-0.71	-0.11	0.43	0.21	1.25	0.80	-1.25
	20	0.71	-0.71	-4.48	-5.52	-2.12	0.24	4.01	-5.42

Each Percentage Time Score in Appendix B represents the normalised score for a particular 5-minute period (see Appendix A). The base for the normalisation is the pre-experimental rest condition data (see section 5.5)

ALPHA FEEDBACK GROUP - PERCENTAGE TIME HIGH ALPHA IN z-SCORES
(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1	-0.50	0.50	3.17	2.87	6.83	5.50	5.17	10.87
	2	-0.71	-0.71	2.97	3.68	5.37	4.24	0.71	-0.71
	3	-0.71	0.71	-4.08	-1.99	-2.78	-2.21	9.26	0.71
	4	0.71	-0.71	15.96	10.30	10.91	9.09	1.31	2.32
	5	0.0	0.0	6.25	3.50	-0.75	5.75	-0.75	12.25
	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	7	0.33	-0.33	1.33	-2.33	-3.33	0.67	-8.00	-2.00
	8	0.71	-0.71	-0.34	-0.34	-0.45	-0.13	-0.18	-2.62
	9	-0.71	0.71	3.94	3.36	1.15	0.0	2.06	2.97
	10	0.71	-0.71	0.0	0.37	0.93	1.70	0.28	0.0
	11	0.0	0.0	0.33	0.67	1.00	4.00	6.67	4.33
	12	0.71	-0.71	0.19	-0.57	-0.28	-0.52	-0.71	-0.71
	13	0.71	-0.71	0.0	1.41	2.83	2.83	-2.12	0.0
	14	-0.71	0.71	3.18	1.15	-1.33	0.53	6.89	8.84
	15	-0.71	0.71	1.48	1.40	1.85	1.13	-1.51	0.0
	16	-0.71	0.71	3.54	0.71	-0.71	2.12	0.71	-2.83
	17	0.71	-0.71	-0.71	-0.38	-0.71	0.0	1.79	-0.71
	18	-0.71	0.71	0.12	0.88	0.66	4.86	6.94	5.13
	19	0.71	-0.71	-9.75	-0.42	1.84	-1.56	7.21	-4.95
	20	0.0	0.0	15.00	5.50	12.16	5.00	-0.50	-1.67

ALPHA FEEDBACK GROUP - PERCENTAGE TIME LOW ALPHA IN z-SCORES
(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1								
	2	0.71	-0.71	15.46	12.63	14.14	13.13	-4.34	6.77
	3	-0.71	0.71	0.0	-0.60	0.0	-0.49	-0.71	-0.71
	4	0.71	-0.71	1.74	0.67	1.03	0.71	3.70	3.05
	5	0.0	0.0	0.86	0.86	1.14	4.00	0.0	10.29
	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	7	0.33	-0.33	14.33	5.00	9.22	7.89	14.56	6.33
	8	0.0	0.0	0.66	0.0	0.66	2.00	1.00	0.0
	9	-0.71	0.71	-0.71	-0.71	2.59	0.71	-0.71	-0.71
	10	-0.71	0.71	-0.71	-0.28	-0.57	-0.28	0.28	-0.71
	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	12	-0.71	0.71	0.0	0.61	0.52	0.92	3.68	3.06
	13	0.71	-0.71	0.30	1.06	0.63	1.73	-1.17	-2.37
	14	-0.71	0.71	0.71	-0.71	-0.71	4.24	4.24	7.78
	15	0.71	-0.71	1.84	0.14	-1.84	2.69	-1.27	5.80
	16	0.0	0.0	0.0	1.33	0.0	2.00	0.0	0.67
	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	18	0.0	0.0	1.00	2.67	0.33	2.00	4.00	1.00
	19	0.43	-0.43	0.43	-1.86	6.71	6.43	5.29	12.43
	20	0.71	-0.71	0.24	-0.37	0.0	-0.99	0.0	-0.49

(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1	-0.71	0.71	-2.35	-3.76	-3.76	-5.40	9.25	9.93
	2	0.71	-0.71	-0.76	-4.34	3.08	-1.51	-2.55	-1.93
	3	-0.71	0.71	-1.30	-6.60	-0.71	1.41	-1.89	-1.53
	4	0.71	-0.71	0.74	-1.11	1.72	-1.18	-4.26	-1.61
	5	-0.71	0.71	-3.41	-10.01	-15.48	-17.83	-2.59	-1.40
	6	-0.71	0.71	-17.54	-22.73	-32.63	-42.28	15.96	6.21
	7	-0.71	0.71	3.04	2.33	1.24	1.37	1.41	0.27
	8	-0.71	0.71	-1.40	-9.60	-10.80	-56.60	-6.60	-3.30
	9	0.71	-0.71	-2.53	-4.31	-4.17	-5.22	-4.63	-3.13
	10	-0.71	0.71	-5.36	8.20	18.92	6.98	15.28	13.26

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME BETA IN z-SCORES

(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1	-0.71	0.71	0.34	-1.02	0.92	-2.44	-1.55	-1.55
	2	-0.71	0.71	-0.30	5.35	-1.31	-4.55	1.31	1.72
	3	0.71	-0.71	1.41	6.89	3.18	4.95	1.41	0.18
	4	0.71	-0.71	3.36	2.83	1.94	1.94	-1.06	-1.59
	5	-0.71	0.71	0.71	6.97	10.10	6.06	0.30	-0.91
	6	-0.71	0.71	0.50	0.70	7.79	4.30	4.10	-1.10
	7	0.71	-0.71	-0.42	-0.71	-0.42	-0.21	-0.42	0.71
	8	-0.71	0.71	-1.33	-0.33	-0.67	5.33	3.33	-1.33
	9	-0.71	0.71	2.12	-3.74	-6.36	-6.36	-0.71	-4.75
	10	0.71	-0.71	4.67	2.33	3.33	2.67	-0.67	-4.33

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME HIGH ALPHA IN z-SCORES

(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1	0.0	0.0	2.00	2.00	0.33	2.33	2.33	2.67
	2	0.71	-0.71	-4.48	-2.71	5.66	-0.12	-5.42	-0.71
	3	0.0	0.0	0.0	5.00	2.67	9.00	1.00	2.33
	4	0.71	-0.71	0.71	-0.71	1.41	4.24	0.71	0.71
	5	0.71	-0.71	7.07	6.36	-3.54	-4.95	-1.41	-1.41
	6	0.50	-0.50	7.30	7.10	3.70	5.90	15.70	3.50
	7	-0.71	0.71	-1.23	0.79	-0.18	1.13	0.0	-1.31
	8	-0.71	0.71	-1.41	-2.12	-1.41	-2.12	-6.36	-6.36
	9	-0.71	0.71	0.47	-1.18	-2.83	4.24	14.38	2.59
	10	-0.71	0.71	-1.72	-0.20	-1.21	-2.02	-1.62	-1.82

ADVANCED MEDITATOR GROUP - PERCENTAGE TIME LOW ALPHA IN z-SCORES

(Short-Term)

Time		Pre- Experimental Rest		Experimental				Post- Experimental Rest	
		5	10	15	20	25	30	35	40
Subject	1	0.0	0.0	0.33	0.0	0.33	0.0	0.0	1.33
	2	-0.71	0.71	-2.12	-0.71	4.95	2.12	0.71	1.41
	3	-0.14	0.14	11.29	9.29	9.86	0.14	7.00	-0.71
	4	-0.71	0.71	-2.29	0.54	0.99	-0.71	0.25	0.25
	5	-0.71	0.71	0.25	-4.72	-6.65	-7.04	-0.48	5.23
	6	-0.71	0.71	-11.31	-16.38	-15.09	-11.79	14.85	14.50
	7	0.71	-0.71	-0.56	0.52	0.0	0.71	0.0	-0.66
	8	0.71	-0.71	0.67	0.64	3.31	-6.56	5.02	2.48
	9	0.17	-0.17	5.83	-5.50	-6.17	-6.50	10.83	1.17
	10	-0.71	0.71	-0.95	0.41	-0.37	1.78	-0.71	-0.27

NORMALISED EEG DATA (LONG-TERM BASE)

ALPHA FEEDBACK GROUP - PERCENTAGE TIME ALPHA IN z-SCORES

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	-0.21	0.21	1.21	-1.21	-2.46	0.0	-0.62	0.0	2.37	0.87	11.69	8.24
2	-0.86	0.0	-0.59	1.38	-14.87	-8.30	-7.92	0.62	-3.00	-0.97	-5.79	-1.41
3	0.54	-0.73	-0.94	1.14	5.67	3.86	2.74	4.10	3.23	4.72	9.78	5.23
4	1.07	0.44	-1.27	-0.24	3.64	0.89	7.52	6.03	5.74	5.70	5.33	3.40
5	-0.29	-1.21	0.37	1.14	2.58	-0.22	6.04	3.61	3.46	8.54	-2.61	-0.81
6	0.0	0.0	0.0	0.0	12.00	5.50	9.25	10.00	9.5	25.00	40.5	19.5
7	0.83	-1.17	0.83	-0.49	-1.24	-2.38	3.49	0.21	1.39	-0.11	2.86	4.50
8	-1.14	-0.52	0.66	1.00	4.88	1.50	0.27	-2.21	0.32	2.52	3.32	3.19
9	-0.28	-1.13	1.27	0.14	21.21	43.40	65.46	35.77	49.48	59.38	38.17	55.56
10	-0.39	-0.32	-0.76	1.47	9.22	5.49	20.99	20.84	26.05	17.78	11.82	26.72
11	-0.46	-0.29	1.48	-0.73	-1.52	-4.43	-3.28	-1.87	-0.64	3.85	-5.31	-5.92
12	0.82	0.87	-1.12	-0.56	1.17	1.34	3.40	3.90	2.12	1.85	4.88	4.71
13	1.07	0.41	-1.29	-0.19	5.32	5.98	5.90	4.17	3.72	3.90	1.75	0.25
14	1.47	-0.21	-0.52	-0.73	3.84	3.65	3.84	0.42	0.26	0.80	4.63	4.01
15	1.29	0.19	-0.41	-1.07	-3.35	3.86	3.63	3.52	3.31	3.71	1.74	2.95
16	-0.46	-0.93	0.0	1.39	17.13	6.94	40.74	45.83	50.92	53.23	53.23	54.62
17	1.40	-0.79	0.0	-0.65	0.44	0.0	-0.10	-0.10	0.72	0.72	-0.51	-0.92
18	-0.15	-1.20	0.12	1.23	3.20	1.45	2.36	2.24	2.94	3.67	4.39	2.81
19	1.08	0.53	-0.43	-1.18	6.88	9.59	6.18	7.18	12.14	8.89	8.29	12.69
20	1.13	0.23	0.0	-1.29	8.82	6.75	9.20	9.20	8.96	6.71	3.26	4.45

ALPHA FEEDBACK GROUP - PERCENTAGE TIME BETA IN z-SCORES

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	-0.69	-0.99	1.09	0.60	15.23	12.78	8.25	6.66	0.96	3.35	3.26	-1.12
2	-0.87	-0.87	0.87	0.87	-1.73	-0.29	0.14	-0.58	0.0	0.58	1.15	1.15
3	-0.89	0.52	1.15	-0.78	-1.09	-0.86	-1.46	-1.26	-0.38	-0.47	-0.84	0.35
4	-0.53	0.47	1.15	-1.09	6.56	4.88	1.71	-1.27	-0.84	-0.65	1.15	0.53
5	1.31	0.23	-0.58	-0.95	0.0	2.31	0.78	0.90	3.97	3.54	3.21	2.13
6	-0.94	-0.52	1.36	0.10	17.05	16.68	11.00	10.48	6.57	5.73	3.44	14.80
7	0.18	-0.66	-0.87	1.34	5.95	6.69	6.37	7.42	8.26	6.27	8.57	7.94
8	0.0	0.58	0.85	-1.39	10.84	3.57	10.78	8.26	6.97	6.29	2.69	4.05
9	0.51	-0.54	-1.09	1.12	-0.42	1.00	-0.23	-0.85	0.20	-1.28	-0.66	-2.26
10	0.64	-0.51	-1.14	1.02	12.71	19.94	-0.51	-2.16	-2.67	-0.13	1.52	-8.64
11	-0.61	-0.75	1.43	0.0	4.71	16.18	12.08	12.08	11.90	11.26	19.73	15.63
12	-0.87	-0.11	-0.44	1.42	-0.44	0.0	0.0	0.51	0.18	1.47	-1.35	-0.20
13	-0.22	-0.49	-0.75	1.46	-0.75	-1.91	-0.31	0.0	-1.11	-0.58	2.53	3.42
14	-0.77	-0.91	1.13	0.55	-2.61	-3.05	0.59	1.26	0.11	-0.16	-2.54	-2.47
15	-0.60	0.0	-0.78	1.42	0.87	4.18	0.69	-1.70	0.14	0.32	0.0	3.08
16	0.0	1.37	-0.94	-0.49	2.38	-0.33	0.39	-0.72	-1.14	-2.44	0.68	-3.06
17	0.0	-0.63	1.40	-0.79	0.42	1.89	1.79	1.32	1.13	0.49	2.15	2.11
18	-1.38	1.01	0.19	0.19	-3.30	-0.70	-1.73	0.19	-2.54	-1.73	-1.45	-2.27
19	-1.34	-0.10	0.44	1.00	0.52	-0.54	-0.10	0.30	0.13	0.90	0.57	-0.94
20	-0.80	1.45	-0.48	-0.16	-1.77	-2.25	-3.54	-3.86	-2.73	-1.93	-3.64	-3.86

Each Percentage Time Score in Appendix C represents the normalised score for a particular 5-minute period (see Appendix A). The base for the normalisation is the pre-training rest condition data (see section 5.5)

ALPHA FEEDBACK GROUP - PERCENTAGE TIME HIGH ALPHA IN z-SCORES

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	-0.57	0.52	1.12	-1.07	-0.57	-0.87	0.22	0.12	1.32	0.92	0.82	2.51
2	-1.38	0.0	0.42	0.95	-1.95	-2.22	-1.52	-1.38	-1.06	-1.28	-1.95	-2.22
3	0.0	-0.18	-1.12	1.31	8.39	11.07	2.01	5.96	4.85	5.55	27.25	11.07
4	1.46	-0.19	-0.52	-0.74	-6.15	-7.69	10.50	4.33	4.99	3.00	-5.49	-4.38
5	0.47	1.15	-0.56	-1.07	-2.78	-2.78	-1.50	-0.38	-3.29	1.15	-3.29	5.60
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.15	-1.28	0.17	0.0	-1.07	-1.15	-0.94	-1.41	-1.54	-1.02	-2.13	-1.37
8	0.87	-0.87	0.87	-0.87	4.33	-2.35	-0.62	-0.62	-1.11	0.37	0.12	0.87
9	0.0	-0.48	1.42	-0.86	-1.63	0.90	6.68	5.64	1.70	-0.38	3.32	4.95
10	1.02	0.13	0.22	-1.38	4.66	0.22	2.62	3.59	5.37	7.76	3.33	2.71
11	-0.95	-0.63	1.26	0.32	-4.11	-4.11	-3.79	-3.48	-3.16	-0.32	2.21	0.0
12	-0.29	-0.29	1.44	-0.87	3.18	-1.15	1.59	-0.72	0.14	-0.58	-1.15	-1.15
13	-0.86	-0.48	1.43	0.0	0.0	-0.29	0.0	0.29	0.67	0.67	-0.67	0.0
14	0.83	0.83	-1.17	-0.49	0.57	0.99	1.72	1.12	0.39	0.94	2.81	3.38
15	1.27	0.30	-0.61	-0.96	-0.16	1.36	2.19	2.10	2.59	1.81	-1.01	0.70
16	0.20	-1.39	0.20	0.99	-1.39	0.99	3.38	0.20	-1.39	1.79	0.20	2.58
17	0.0	0.0	0.0	0.0	4.33	0.0	0.0	1.00	0.0	2.33	7.67	0.0
18	0.0	-1.25	0.0	1.20	2.25	3.36	2.94	3.33	3.33	6.65	8.29	6.96
19	-1.26	-0.20	1.13	0.33	1.66	0.33	-8.15	0.60	2.72	-0.46	7.75	-3.64
20	0.78	-1.31	0.78	-0.26	-1.51	-1.51	4.75	0.78	3.57	0.57	-1.72	-2.21

ALPHA FEEDBACK GROUP - PERCENTAGE TIME LOW ALPHA IN z-SCORES

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	0.0	0.0	0.0	0.0	0.0	0.0	0.83	0.0	0.83	0.0	0.0	3.33
2	1.48	-0.26	-0.70	-0.51	-2.00	-2.29	1.06	0.47	0.78	0.58	-3.05	-0.74
3	0.63	-1.47	0.21	0.63	-1.47	3.99	1.05	-1.05	1.05	-0.63	-1.47	-1.47
4	-0.53	-0.53	0.34	0.72	6.84	1.34	10.84	6.72	8.09	6.84	18.47	15.97
5	-0.21	-0.63	-0.63	1.47	-0.63	-0.63	-0.21	-0.21	0.0	-0.33	-0.63	4.41
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	-0.94	-0.40	1.39	-2.20	-2.74	9.13	1.57	4.99	3.91	9.31	2.65
8	-0.86	-0.86	1.05	0.67	-0.86	-0.86	0.0	-0.86	0.0	1.43	0.29	-0.86
9	1.50	-0.50	-0.50	-0.50	-0.50	2.50	-0.50	-0.50	6.50	2.50	6.50	12.50
10	-0.50	-0.50	1.50	-0.50	-0.50	6.17	-0.50	1.50	0.17	1.50	-0.50	-0.50
11	-0.78	0.26	-0.78	1.31	-0.78	-0.78	-0.78	-0.78	-0.78	-0.78	-0.78	-0.78
12	-0.89	1.19	-0.76	0.46	-3.21	4.13	0.46	3.64	3.15	5.23	18.23	16.35
13	-0.30	1.23	0.22	-1.16	2.18	0.79	1.79	2.54	2.11	3.20	0.33	-0.85
14	-0.78	-0.78	0.26	1.31	-0.78	0.26	0.26	-0.78	-0.78	2.87	2.87	5.48
15	-0.34	-0.93	-0.15	1.42	0.83	-0.15	1.61	0.44	-0.93	2.20	-0.54	4.34
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.33	0.0	2.00	0.0	0.67
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	-0.87	-0.87	0.87	0.87	-0.87	-0.87	4.33	12.99	0.87	9.53	19.92	4.33
19	-0.76	-0.76	0.16	1.35	1.75	1.35	1.75	0.69	4.65	4.51	3.99	7.28
20	0.71	-0.57	-1.11	0.97	17.06	8.64	14.30	10.63	12.39	6.98	13.12	9.92

HEART-RATE DATA

ALPHA FEEDBACK GROUP - HEART RATE (beats/min.)

Time	Pre-Training Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	74.8	74.0	72.3	71.0	87.5	86.3	85.0	79.5	80.0	81.0	79.0	78.0
2	91.3	92.0	92.5	88.0	89.7	85.3	85.0	85.3	84.7	85.3	84.0	84.7
3	82.0	75.3	79.0	77.0	81.7	75.7	79.0	78.3	80.3	76.7	70.0	71.7
4	73.0	72.0	71.5	70.0	71.0	71.0	68.0	68.0	66.0	65.0	67.5	65.5
5	62.5	61.5	60.0	61.5	66.5	62.5	66.0	64.5	65.5	64.0	64.5	63.5
6	70.7	68.7	68.0	68.7	66.7	65.3	68.0	66.7	65.7	66.3	65.3	65.3
7	71.0	70.0	70.0	72.0	84.5	84.0	77.5	77.5	78.5	81.0	81.0	82.5
8	77.5	74.5	74.5	73.0	77.0	74.7	75.3	72.3	72.7	70.3	70.0	69.3
9	80.5	76.5	78.0	74.5	78.0	76.0	71.0	72.0	72.0	73.0	71.0	71.3
10	77.0	81.0	78.0	80.5	69.0	69.0	66.0	65.0	66.0	66.0	65.0	67.0
11	83.5	80.5	82.0	78.5	89.0	84.0	88.0	87.0	87.0	85.0	85.0	86.0
12	69.7	68.7	71.7	68.7	65.0	61.0	59.0	60.0	62.0	61.0	61.0	63.0
13	60.7	57.7	57.3	59.7	72.0	67.3	74.0	73.0	73.3	70.0	68.5	70.0
14	77.7	78.3	78.3	79.0	77.0	74.0	76.0	78.0	74.0	82.0	82.0	83.0
15	78.7	79.3	81.3	80.0	82.0	83.0	81.0	82.0	83.0	81.0	81.0	81.0
16	80.0	80.0	78.5	77.5	84.0	79.0	85.0	84.0	84.0	83.0	79.0	80.0
17	71.7	70.3	69.7	68.0	66.0	66.0	69.0	64.0	59.0	60.0	61.0	61.0
18	81.7	79.7	78.7	80.3	83.0	79.0	77.0	80.0	78.0	75.0	79.0	82.0
19	92.0	92.7	92.3	91.3	81.0	79.0	81.0	84.0	81.0	83.0	80.0	82.0
20	77.0	76.3	76.3	75.5	79.0	81.0	74.0	75.0	71.0	69.0	72.0	72.0

ADVANCED MEDITATOR GROUP - HEART RATE (beats/min.)

Time	Rest				Pre-Experimental Rest		Experimental				Post-Experimental Rest	
	5	10	15	20	5	10	15	20	25	30	35	40
Subject 1	67.0	65.0	65.0	64.0	84.3	85.0	82.0	83.0	81.7	80.0	77.7	80.7
2	75.0	74.0	75.0	72.0	92.0	87.0	88.7	87.3	85.3	85.0	86.9	88.9
3	71.0	70.0	70.0	72.0	76.0	76.0	73.7	75.0	74.3	73.7	73.2	78.2
4	68.0	68.0	67.0	68.0	68.3	70.7	68.3	70.0	68.7	69.0	68.9	68.9
5	62.0	63.0	64.0	62.0	62.0	61.7	61.3	61.0	59.3	58.3	63.8	66.3
6	70.0	71.0	71.0	68.0	72.0	71.0	70.3	67.3	66.7	63.7	63.6	63.1
7	77.0	77.0	74.0	76.0	83.7	81.7	81.0	78.7	76.0	75.0	77.2	74.2
8	76.0	78.0	76.0	75.0	85.0	84.0	82.3	82.0	81.0	81.3	77.2	79.2
9	75.0	75.0	76.0	78.0	75.0	76.3	76.3	78.0	77.0	76.7	76.5	72.5
10	66.0	67.0	68.0	67.0	73.3	74.3	71.0	73.3	72.3	73.3	67.5	69.5

Each Heart-Rate Score in Appendix D represents the mean score obtained over four experimental sessions for a particular 5-minute period (see section 5.3.1)

AUTONOMIC BALANCE DATA

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

 $\bar{A}$

		20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
		Before	After	Difference	Before	After	Difference
Subjects	1	73.4	69.8	-3.6	65.5	71.5	5.9
	2	53.1	51.1	-2.0	66.9	61.4	-5.5
	3	74.6	66.4	-8.2	67.4	72.8	5.4
	4	64.5	77.9	13.4	75.6	78.4	2.8
	5	75.3	76.9	1.6	83.6	86.2	2.6
	6	80.7	75.2	-5.5	78.5	83.2	4.7
	7	58.5	61.0	2.5	58.9	64.8	6.9
	8	70.9	70.7	-0.2	66.3	71.1	4.8
	9	71.1	81.1	10.1	63.9	70.0	6.1
	10	65.2	68.1	2.9	67.4	73.2	5.8
	11	56.0	65.0	-1.0	65.9	66.0	0.1
	12	73.5	75.7	2.2	80.0	80.3	0.3
	13	66.8	75.4	8.6	72.7	78.0	5.3
	14	65.8	61.0	-4.8	58.4	68.9	10.5
	15	73.5	70.2	-3.3	81.1	83.9	2.8
	16	59.3	59.0	-0.3	73.5	79.4	5.9
	17	69.6	75.2	5.6	80.9	80.9	0.0
	18	71.8	75.3	3.5	76.6	78.5	1.9
	19	67.2	67.8	0.6	66.2	68.9	2.7
	20	70.8	73.2	2.4	67.5	67.6	0.1

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

 $\bar{A}$

		20 minute Rest Condition			20 minute Experimental Condition		
		Before	After	Difference	Before	After	Difference
Subjects	1	69.4	69.8	0.4	58.3	61.9	3.6
	2	68.0	69.3	1.3	63.4	70.2	6.8
	3	65.9	65.1	-0.8	64.7	66.2	1.5
	4	77.5	68.6	-8.9	71.5	69.1	-2.4
	5	79.5	80.0	0.5	78.8	80.4	1.6
	6	71.9	79.7	7.8	73.1	67.4	-5.7
	7	61.3	53.9	-7.4	62.3	67.2	4.9
	8	67.0	67.6	0.6	60.7	65.1	4.4
	9	65.8	69.2	3.4	71.6	63.8	-7.8
	10	78.4	71.2	-7.2	79.7	77.2	-2.5

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Dermographia Persistence)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	50.8	47.8	-3.0	46.2	46.2	0.0
2	59.9	53.8	-6.1	53.8	46.2	-7.6
3	47.0	47.8	0.8	46.2	47.0	0.8
4	90.2	97.8	7.6	56.8	56.8	0.0
5	52.3	52.3	0.0	55.3	49.3	-6.0
6	47.8	47.0	-0.8	46.2	47.8	1.6
7	47.0	46.2	-0.8	47.0	47.8	0.8
8	49.3	49.3	0.0	46.2	47.8	1.6
9	47.0	46.2	-0.8	45.2	45.0	-0.2
10	49.3	47.8	-1.5	56.8	48.5	-8.3
11	47.8	46.2	-1.6	46.2	45.8	-0.4
12	55.3	47.8	-7.5	53.0	49.3	-3.7
13	45.5	45.5	0.0	45.5	45.5	0.0
14	46.2	47.8	1.6	46.2	46.7	0.5
15	55.3	50.8	-4.5	75.0	75.0	0.0
16	47.8	47.8	0.0	46.2	45.9	-0.3
17	49.3	45.5	-3.8	45.9	45.5	-0.4
18	46.7	46.7	0.0	55.3	55.3	0.0
19	46.5	46.7	0.2	56.1	59.8	3.7
20	48.2	50.8	2.6	59.8	50.8	-9.0

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Dermographia Persistence)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	48.0	47.0	-1.0	47.1	46.2	-0.9
2	67.4	57.6	-9.8	67.4	67.0	-0.4
3	47.0	45.8	-1.2	46.2	45.9	-0.3
4	47.4	46.2	-1.2	47.3	47.3	0.0
5	47.3	47.6	0.3	48.5	48.0	-0.5
6	45.6	46.5	0.9	46.5	46.4	-0.1
7	46.2	45.0	-1.2	45.8	46.2	0.4
8	75.0	75.0	0.0	75.0	75.0	0.0
9	47.8	47.0	-0.8	50.3	50.2	-0.1
10	47.8	46.5	-1.3	46.4	46.7	0.3

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Salivary Output)

	20 minute <u>Pre-Training Rest Condition</u>			20 minute <u>Experimental Condition</u>		
	Before	After	Difference	Before	After	Difference
Subjects 1	38.1	43.6	5.5	44.8	44.8	0.0
2	49.4	43.6	-5.8	58.1	58.7	0.6
3	46.5	46.5	0.0	58.1	58.1	0.0
4	61.0	61.0	0.0	58.1	61.0	2.9
5	43.6	46.5	2.9	46.5	49.4	2.9
6	46.5	46.5	0.0	47.7	48.8	1.1
7	47.1	47.1	0.0	52.3	52.3	0.0
8	51.2	52.9	1.7	58.1	58.7	0.6
9	61.0	55.2	-5.8	36.1	36.7	0.6
10	36.7	35.5	-1.2	35.0	36.1	1.1
11	44.2	38.4	-5.8	43.6	46.8	3.2
12	63.8	63.8	0.0	51.7	52.3	0.6
13	63.8	66.7	2.9	63.2	69.0	5.8
14	49.4	43.6	-5.8	49.4	46.5	-2.9
15	37.2	32.8	-4.4	36.1	45.3	9.2
16	36.1	32.8	-3.3	54.0	53.4	-0.6
17	46.8	69.6	22.8	58.1	58.1	0.0
18	46.2	61.0	14.8	60.3	64.9	4.6
19	49.4	46.5	-2.9	53.4	52.3	-1.1
20	46.5	52.3	5.8	54.6	53.4	-1.2

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Salivary Output)

	20 minute <u>Rest Condition</u>			20 minute <u>Experimental Condition</u>		
	Before	After	Difference	Before	After	Difference
Subjects 1	50.0	50.0	0.0	52.8	54.6	1.8
2	45.3	48.2	2.9	55.2	55.7	0.5
3	46.9	47.1	0.2	46.5	46.9	0.4
4	47.1	43.0	-4.1	46.9	43.6	-3.3
5	53.4	54.6	1.2	53.4	52.8	-0.6
6	73.6	77.1	3.5	66.7	66.9	0.2
7	41.8	36.6	-5.2	41.3	39.0	-2.3
8	46.5	50.0	3.5	45.3	48.8	3.5
9	41.3	42.4	1.1	44.7	46.5	1.8
10	47.7	54.6	6.9	55.2	58.1	2.9

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Heart Period)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	63.3	49.7	-13.6	36.1	48.4	12.3
2	48.4	36.1	-12.3	48.4	33.3	-15.1
3	51.1	43.5	-7.6	36.1	43.5	7.4
4	36.2	52.4	16.2	40.2	53.9	13.7
5	60.0	61.6	1.6	66.9	78.6	11.7
6	70.7	65.1	-5.6	66.9	72.7	5.8
7	39.1	39.1	0.0	32.4	36.2	3.8
8	47.1	48.4	1.3	45.7	61.6	15.9
9	33.3	55.3	22.0	36.1	43.5	7.4
10	46.9	52.4	5.5	46.9	55.3	8.4
11	33.3	41.3	8.0	41.1	41.3	0.2
12	48.9	56.8	7.9	63.3	61.6	-1.7
13	48.8	60.0	11.2	54.2	66.9	12.7
14	35.1	33.3	-1.8	40.2	42.4	2.2
15	48.9	44.7	-4.2	68.8	72.7	3.9
16	35.1	43.1	8.0	41.3	51.1	9.8
17	43.5	52.4	8.9	56.8	56.8	0.0
18	43.5	44.7	1.2	55.3	55.3	0.0
19	27.5	29.0	1.5	29.0	32.4	3.4
20	49.7	63.7	14.0	39.1	49.7	10.6

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Heart Period)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	55.3	55.3	0.0	24.1	33.3	9.2
2	39.1	44.7	5.6	34.2	43.5	9.3
3	53.9	52.4	-1.5	42.4	53.9	11.5
4	66.9	55.3	-11.6	56.8	52.4	-4.4
5	60.0	66.9	6.9	58.3	61.6	3.3
6	49.7	56.8	7.1	48.3	43.5	-4.8
7	43.5	42.4	-1.1	34.2	45.9	11.7
8	42.4	51.1	8.7	36.1	40.2	4.1
9	46.9	48.9	2.0	49.7	40.2	-9.5
10	61.6	60.0	-1.6	58.3	56.8	-1.5

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Palmar Conductance)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	61.5	61.5	0.0	60.7	59.5	-1.2
2	11.7	29.0	17.3	37.6	43.0	5.4
3	55.7	43.0	-12.7	58.4	60.5	2.1
4	22.5	43.0	20.5	47.7	35.4	-12.3
5	57.8	56.0	-1.8	59.7	54.9	-4.8
6	51.6	51.6	0.0	54.9	57.6	2.7
7	49.6	54.9	5.3	48.9	56.0	7.1
8	59.7	47.3	-12.4	43.0	43.0	0.0
9	59.2	67.8	8.6	47.3	47.3	0.0
10	60.0	61.2	1.2	59.7	58.3	-1.4
11	57.9	60.7	2.8	48.8	47.7	-1.1
12	59.5	57.7	-1.8	60.0	61.0	1.0
13	46.0	39.8	-6.2	46.0	37.9	-8.1
14	52.2	50.9	-1.3	60.4	57.4	-3.0
15	53.6	55.3	1.7	53.6	47.7	-5.9
16	41.3	47.7	6.4	60.4	61.0	0.6
17	55.8	55.0	-0.8	59.1	56.7	-2.4
18	59.1	63.1	4.0	55.5	58.7	3.2
19	63.1	61.1	-2.1	57.1	61.2	4.1
20	52.2	41.3	-10.9	42.6	35.7	-6.9

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Palmar Conductance)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	46.0	43.9	-2.1	46.0	51.3	5.3
2	54.2	57.9	3.7	44.7	61.4	16.7
3	45.9	41.3	-4.6	49.9	43.9	-6.0
4	49.9	58.6	8.7	55.8	56.1	0.3
5	62.5	53.6	-8.9	60.4	59.1	-1.3
6	45.1	51.3	6.2	51.3	41.3	-10.0
7	41.3	27.3	-14.0	49.9	56.1	6.2
8	49.9	33.6	-16.3	52.2	46.0	-6.2
9	52.2	55.8	3.6	55.5	43.9	-11.6
10	32.4	37.3	4.9	54.7	46.0	-8.7

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Volar Conductance)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	45.2	42.0	-3.2	49.1	48.0	-1.1
2	23.4	23.4	0.0	57.5	57.5	0.0
3	45.4	52.6	7.2	52.4	45.6	-6.8
4	49.4	54.7	5.3	54.2	53.3	-0.9
5	44.0	49.4	5.4	55.4	54.2	-1.2
6	47.6	54.4	6.8	51.6	53.5	1.9
7	41.7	41.7	0.0	51.6	51.6	0.0
8	41.8	47.7	5.9	50.2	54.2	4.0
9	49.5	53.3	3.8	53.8	54.5	0.7
10	48.4	52.2	3.8	54.5	53.5	-1.0
11	9.1	54.2	45.1	54.6	54.9	0.3
12	31.2	55.2	24.0	53.3	55.0	1.7
13	43.2	49.5	6.3	37.9	49.5	11.6
14	53.0	53.8	0.8	53.5	45.6	-7.9
15	53.5	44.3	-9.2	44.0	44.6	0.6
16	52.6	54.9	2.3	54.5	53.9	-0.6
17	20.8	46.2	25.4	35.2	53.0	17.8
18	56.0	56.0	0.0	56.0	56.0	0.0
19	49.7	50.5	0.8	48.5	52.2	3.7
20	45.6	51.7	6.1	52.0	42.8	-9.2

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Volar Conductance)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	43.9	42.8	-1.1	52.0	53.3	1.3
2	53.8	54.8	1.0	53.5	54.9	1.4
3	37.9	53.9	16.0	54.8	54.6	-0.2
4	51.7	45.6	-6.1	54.6	54.9	0.3
5	52.2	53.5	1.3	52.0	54.9	2.9
6	23.1	50.1	27.0	36.9	51.0	14.1
7	47.8	47.8	0.0	52.6	50.1	-2.5
8	53.0	5.2	-47.8	32.1	49.5	17.4
9	55.4	55.2	-0.2	53.0	53.8	0.8
10	54.9	55.5	0.6	54.2	55.4	1.2

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Respiration Period)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	51.5	54.6	3.1	48.3	50.4	2.1
2	36.6	36.6	0.0	38.7	38.7	0.0
3	69.6	58.9	-10.7	34.5	58.9	24.4
4	40.9	48.3	7.4	133.4	133.4	0.0
5	43.0	46.2	3.2	76.0	76.0	0.0
6	63.2	69.6	6.4	63.2	69.6	6.4
7	46.2	40.9	-5.3	43.0	35.5	-7.5
8	38.7	38.7	0.0	38.7	48.3	9.6
9	50.4	54.6	4.2	50.4	85.5	35.1
10	46.2	50.4	4.2	58.9	69.6	10.7
11	32.9	46.2	13.3	38.7	54.6	15.9
12	62.1	58.9	-3.2	65.3	68.5	3.2
13	50.4	66.4	16.0	47.2	56.8	9.6
14	41.9	41.9	0.0	33.4	36.6	3.2
15	56.8	53.6	-3.2	54.6	64.3	9.7
16	36.6	38.7	2.1	39.8	41.9	2.1
17	69.6	56.8	-12.8	85.5	97.2	11.7
18	51.5	57.9	6.4	49.4	47.2	-2.2
19	39.8	37.7	-2.1	41.9	45.1	3.2
20	47.2	46.2	-1.0	40.9	43.0	2.1

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Respiration Period)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	53.6	54.6	1.0	48.3	55.7	7.4
2	47.2	43.0	-4.2	41.9	43.0	1.1
3	51.5	46.2	-5.3	44.0	46.2	2.2
4	49.4	44.0	-5.4	41.9	40.9	-1.0
5	54.6	54.6	0.0	52.6	58.9	6.3
6	51.5	47.2	-4.3	49.4	49.4	0.0
7	41.9	40.9	-1.0	41.9	41.9	0.0
8	40.9	44.0	3.1	35.5	36.6	1.1
9	40.9	38.7	-2.2	41.9	41.9	0.0
10	133.4	81.3	-52.1	71.7	110.0	38.3

ALPHA FEEDBACK GROUP - AUTONOMIC BALANCE

(Pulse Pressure)

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	36.2	41.6	5.4	48.0	54.4	6.4
2	41.6	39.4	-2.2	48.0	45.9	-2.1
3	59.8	54.4	-5.4	52.3	52.3	0.0
4	65.1	58.7	-6.4	45.9	48.0	2.1
5	56.6	56.6	0.0	54.4	52.3	-2.1
6	58.7	41.6	-17.1	48.0	50.1	2.1
7	25.5	33.0	7.5	33.0	48.0	15.0
8	54.4	65.1	10.7	50.1	33.7	-16.4
9	65.1	60.8	-4.3	56.6	63.0	6.4
10	33.7	33.0	-0.7	33.7	45.9	12.2
11	37.3	39.4	2.1	60.8	51.2	-9.6
12	42.1	33.7	-8.4	45.9	48.0	2.1
13	33.7	49.9	16.2	57.6	54.4	-3.2
14	60.3	46.9	-13.4	61.9	62.4	0.5
15	69.4	71.5	2.1	64.6	65.1	0.5
16	59.8	33.7	-26.1	69.9	79.0	9.1
17	60.8	44.8	-16.0	60.8	49.9	-10.9
18	59.8	51.2	-8.6	58.5	49.9	-8.6
19	68.9	75.3	6.4	60.8	57.1	-3.7
20	55.0	50.1	-4.9	65.1	63.0	-2.1

ADVANCED MEDITATOR GROUP - AUTONOMIC BALANCE

(Pulse Pressure)

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	44.8	50.1	5.3	48.0	33.7	-14.3
2	51.2	44.3	-6.9	44.8	33.7	-11.1
3	37.8	38.9	1.1	44.8	37.3	-7.5
4	57.6	33.7	-23.9	41.6	42.1	0.5
5	53.3	53.3	0.0	56.6	56.6	0.0
6	58.7	58.7	0.0	58.7	46.9	-11.8
7	48.0	40.5	-7.5	56.6	52.3	-4.3
8	44.3	50.1	5.8	41.6	46.9	5.3
9	43.7	51.7	8.0	58.2	53.3	-4.9
10	54.4	33.7	-20.7	58.7	39.4	-19.3

REACTION-TIME DATA

ALPHA FEEDBACK GROUP - REACTION TIME

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	66.0	77.0	11.0	63.2	58.8	-4.4
2	67.0	68.2	1.2	65.0	67.2	2.2
3	56.1	61.6	5.5	61.5	62.8	1.3
4	62.4	57.8	-4.6	52.4	53.7	1.3
5	62.9	63.8	0.9	45.8	48.5	2.7
6	81.7	80.7	-1.0	73.9	69.1	-4.8
7	54.9	56.7	1.8	52.6	55.4	2.8
8	61.9	63.2	1.3	56.0	54.6	-1.4
9	50.3	52.3	2.0	51.4	63.2	11.8
10	56.0	49.5	-6.5	54.4	61.4	7.0
11	63.8	71.1	7.3	55.4	64.1	8.7
12	48.7	46.9	-1.8	45.2	47.5	2.3
13	54.2	54.9	0.7	55.7	51.8	-3.9
14	57.5	54.3	-3.2	58.6	57.5	-1.1
15	59.8	63.0	3.2	54.8	52.6	-2.2
16	44.1	47.3	3.2	42.0	44.3	2.3
17	59.0	51.3	-7.7	50.9	61.1	10.2
18	57.7	59.4	1.7	57.4	55.0	-2.4
19	54.0	66.1	12.1	55.2	54.2	-1.0
20	49.0	59.5	10.5	51.7	57.9	6.2

ADVANCED MEDITATOR GROUP - REACTION TIME

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	56.0	55.2	-0.8	58.2	53.4	-4.8
2	57.6	64.6	7.0	52.7	61.3	8.6
3	58.6	59.7	1.1	64.3	55.2	-9.1
4	58.0	57.8	-0.2	56.6	55.0	-1.6
5	45.9	47.9	2.0	51.6	53.5	1.9
6	53.6	48.7	-4.9	43.8	48.1	4.3
7	50.0	49.4	-0.6	43.7	48.9	5.2
8	49.9	52.5	2.6	45.9	44.9	-1.0
9	50.0	50.0	0.0	46.8	40.1	-6.7
10	45.9	46.6	0.7	42.7	44.6	1.9

SHORT-TERM MEMORY/PERCEPTUAL SPEED

ALPHA FEEDBACK GROUP
SHORT-TERM MEMORY/PERCEPTUAL SPEED

	20 minute Pre-Training Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	9.2	9.6	0.4	7.2	6.4	-0.8
2	6.4	9.2	2.8	4.8	5.0	0.2
3	5.0	6.0	1.0	6.2	4.0	-2.2
4	7.4	7.0	-0.4	4.0	4.6	0.6
5	7.6	7.2	-0.4	4.6	4.2	-0.4
6	5.4	5.0	-0.4	4.8	4.4	-0.4
7	7.6	9.8	2.2	4.6	3.8	-0.8
8	8.2	6.8	-1.4	3.6	5.2	1.6
9	7.8	6.2	-1.6	5.8	6.6	1.8
10	6.6	9.2	2.6	3.8	6.2	2.4
11	9.4	7.4	-2.0	10.2	10.6	0.4
12	6.2	6.0	-0.2	6.8	4.6	-2.2
13	7.0	7.4	0.4	6.4	5.0	-1.4
14	5.6	6.6	1.0	7.8	4.6	-3.2
15	6.5	8.0	1.5	4.6	6.4	1.8
16	4.2	5.0	0.8	3.8	5.0	1.2
17	6.2	8.2	2.0	5.8	9.4	3.6
18	6.2	8.2	2.0	4.0	4.8	0.8
19	6.6	6.2	-0.4	4.8	3.6	-1.2
20	6.8	7.0	0.2	5.4	8.2	2.8

ADVANCED MEDITATOR GROUP
SHORT-TERM MEMORY/PERCEPTUAL SPEED

	20 minute Rest Condition			20 minute Experimental Condition		
	Before	After	Difference	Before	After	Difference
Subjects 1	5.3	4.6	-0.7	5.4	4.6	-0.8
2	4.4	4.4	0.0	3.6	4.0	0.4
3	6.6	4.8	-1.8	3.4	4.2	0.8
4	13.0	10.0	-3.0	7.0	7.4	0.4
5	6.4	6.8	0.4	5.4	4.6	-0.8
6	3.6	4.8	1.2	4.0	3.6	-0.4
7	7.8	6.2	-1.6	5.0	4.4	-0.6
8	7.6	4.8	-2.8	4.6	4.0	-0.6
9	3.6	3.0	-0.6	3.4	2.6	-0.8
10	6.4	5.8	-0.6	4.8	4.2	-0.6

ALPHA FEEDBACK GROUP - PSYCHOLOGICAL TEST DATA

(Long-Term)

		Barber			Stanford			Marlowe-Crowne		
		B	A	D	B	A	D	B	A	D
Subjects 1		11.5	14.0	3.0	12	12	0	8	7	-1
2		0.0	0.0	0.0	0	1	1	10	8	-2
3		7.5	4.0	-3.5	5	11	6	17	13	-4
4		0.0	0.0	0.0	0	2	2	16	13	-3
5		16.0	14.0	-2.0	10	12	2	13	6	-7
6		1.5	0.0	-1.5	4	5	1	22	21	-1
7		3.5	0.0	-3.5	5	1	-4	15	13	-2
8		11.5	16.0	-4.5	8	12	4	17	15	-2
9		0.0	0.0	0.0	1	1	0	13	14	1
10		2.5	1.5	-1.0	1	2	1	6	3	-3
11		3.0	0.0	-3.0	2	2	0	12	14	2
12		6.0	5.0	-1.0	3	5	2	7	7	0
13		2.5	1.0	-1.5	3	1	-2	15	16	1
14		7.0	3.0	-4.0	3	4	1	4	4	0
15		2.0	0.0	-2.0	1	1	0	6	6	0
16		8.5	8.0	-0.5	5	9	4	7	7	0
17		0.0	0.0	0.0	0	0	0	1	3	2
18		0.0	0.0	0.0	1	1	0	18	22	4
19		4.0	4.0	0.0	3	3	0	11	10	-1
20		12.0	8.0	-4.0	9	12	3	16	11	-5

		Taylor			EPI-N			EPI-E		
		B	A	D	B	A	D	B	A	D
Subjects 1		11	12	1	12	8	-4	14	14	0
2		22	27	5	13	13	0	8	5	-3
3		23	17	-6	15	7	-8	14	20	6
4		22	15	-7	13	12	-1	7	9	2
5		6	4	-2	3	8	5	18	20	2
6		22	23	1	15	15	0	17	12	-5
7		11	7	-4	9	11	2	15	15	0
8		8	6	-2	7	7	0	6	9	3
9		15	7	-8	9	5	-4	14	12	-2
10		19	22	3	14	12	-2	13	8	-5
11		22	27	5	19	18	-1	16	11	-5
12		8	7	-1	1	4	3	7	16	9
13		12	12	0	14	8	-6	16	8	-8
14		34	36	2	22	22	0	13	13	0
15		24	23	-1	16	16	0	14	11	-3
16		12	9	-3	5	2	-3	6	15	9
17		10	9	-1	7	4	-3	11	13	2
18		5	5	0	7	4	-3	16	17	1
19		11	13	2	10	7	-3	14	8	-6
20		14	14	0	7	6	-1	10	9	-1

		Rep. Grid 1			Rep. Grid 2			Rep. Grid 3			Rep. Grid 4		
		B	A	D	B	A	D	B	A	D	B	A	D
Subjects 1		0.02	0.36	0.34	-0.50	-0.48	0.02	0.45	0.26	-0.19	0.90	0.88	-0.02
2		0.38	0.55	0.17	-0.02	0.02	0.04	0.45	0.05	-0.40	-0.40	0.24	0.64
3		-0.48	-0.52	-0.04	-0.90	-0.86	0.04	0.60	0.67	0.07	0.82	0.43	-0.19
4		-0.81	-0.81	0.00	-0.90	-0.90	0.00	0.60	0.79	0.19	0.88	0.83	-0.05
5		-0.50	-0.17	0.33	-0.48	-0.67	-0.19	0.62	0.83	0.21	0.12	0.36	0.24
6		-0.86	-0.74	0.12	-0.79	-0.90	-0.11	0.88	0.93	0.05	0.76	0.93	0.17
7		0.36	-0.24	-0.60	-0.76	-0.86	-0.10	-0.38	0.52	0.90	0.40	0.76	0.36
8		-0.10	-0.19	-0.09	0.10	0.10	0.00	-0.05	0.33	0.38	0.07	0.45	0.38
9		-0.69	-0.43	0.26	-0.86	-0.62	0.24	0.60	0.69	0.09	0.62	0.76	0.14
10		-0.23	-0.26	-0.03	-0.25	-0.26	-0.01	-0.39	-0.45	-0.06	-0.74	-0.76	-0.02
11		0.40	0.20	-0.38	-0.33	-0.40	-0.07	-0.12	-0.40	-0.28	0.29	0.98	0.69
12		-0.71	-0.71	0.00	-0.98	-0.98	0.00	0.88	0.33	-0.55	0.90	0.98	0.08
13		-0.25	-0.21	0.04	-0.42	-0.40	0.02	-0.44	-0.29	0.15	0.84	0.79	-0.05
14		-0.60	-0.33	0.27	-0.83	-0.57	0.26	0.90	0.55	-0.35	0.81	0.17	-0.64
15		0.07	-0.24	-0.31	-0.24	-0.43	-0.19	0.79	0.67	-0.12	0.74	0.50	-0.24
16		-0.95	-0.90	0.05	-0.90	-0.95	-0.05	0.69	0.88	0.19	0.93	0.99	0.06
17		-0.95	-0.79	0.16	-0.98	-0.76	0.22	0.71	0.45	-0.26	0.95	0.83	-0.12
18		-0.98	-0.60	0.38	-0.98	-0.81	0.17	-0.95	0.24	1.19	0.57	0.76	0.19
19		-0.90	-0.62	0.28	-0.93	-0.64	0.29	0.38	-0.29	-0.67	0.93	0.62	-0.31
20		-0.83	-0.90	-0.07	-0.62	-0.76	-0.14	0.88	0.69	-0.19	0.57	0.62	0.05

Note: B = Before
A = After
D = Difference

ALPHA FEEDBACK GROUP - PSYCHOLOGICAL TEST DATA
(Long-Term)

	Rep. Grid 5			Rep. Grid 6			Rep. Grid 7			Rep. Grid 9		
	B	A	D	B	A	D	B	A	D	B	A	D
Subjects 1	-0.05	0.02	0.07	-0.12	0.43	0.55	-0.10	0.19	0.29	0.43	0.60	0.17
2	0.43	-0.12	-0.55	0.29	0.02	-0.27	0.69	-0.10	-0.79	-0.25	0.14	0.40
3	-0.60	-0.17	0.43	0.33	0.57	0.24	0.52	0.76	0.24	0.79	0.93	0.14
4	-0.38	-0.14	0.24	0.83	0.79	-0.04	0.14	-0.12	-0.26	0.76	0.57	-0.19
5	0.12	-0.19	-0.31	0.05	0.52	0.47	0.76	0.74	-0.02	0.77	0.71	-0.08
6	0.14	0.00	-0.14	0.14	0.60	0.46	0.93	0.93	0.00	0.83	0.98	0.15
7	-0.71	-0.45	0.26	0.90	0.88	-0.02	0.26	-0.06	-0.32	0.32	0.79	0.27
8	-0.55	-0.48	0.07	-0.66	-0.02	0.04	-0.76	-0.43	0.33	-0.76	-0.43	0.33
9	-0.48	-0.45	0.03	-0.48	-0.79	1.27	1.00	0.88	-0.12	0.40	0.86	-0.04
10	-0.03	0.21	0.24	-0.14	0.12	0.26	0.31	0.26	-0.05	0.58	0.50	-0.08
11	-0.40	0.19	-0.59	0.38	-0.17	-0.55	0.26	-0.79	-1.05	0.52	-0.93	-1.41
12	-0.12	0.38	0.50	1.00	0.95	-0.05	1.00	0.74	-0.26	1.00	0.95	-0.05
13	-0.86	-0.76	0.10	0.54	0.83	0.29	0.59	0.48	-0.11	0.24	0.38	0.14
14	-0.14	-0.02	0.12	0.36	0.14	-0.22	0.50	0.21	-0.29	0.31	0.60	0.29
15	-0.33	-0.06	0.27	0.05	0.62	0.57	0.52	0.71	0.19	0.55	0.33	-0.12
16	-0.88	-0.86	0.02	0.90	0.90	0.00	0.95	0.90	-0.05	0.93	0.62	-0.31
17	-0.76	-0.76	0.00	0.90	0.74	-0.16	0.83	0.81	-0.02	0.67	0.38	-0.29
18	-0.93	-0.45	0.48	0.43	0.88	0.45	0.95	0.83	-0.12	0.33	0.90	0.57
19	0.02	-0.29	-0.31	0.38	0.76	0.38	0.62	0.05	-0.57	0.95	0.81	-0.14
20	-0.06	0.12	0.18	0.90	0.76	-0.14	0.79	0.81	0.02	0.55	0.57	0.02

	Rep. Grid 10			Rep. Grid 11			Rep. Grid 12			Rep. Grid 13		
	B	A	D	B	A	D	B	A	D	B	A	D
Subjects 1	-0.30	0.57	0.93	-0.43	0.24	-0.19	0.57	0.76	0.19	0.40	0.76	0.36
2	-0.19	0.19	0.38	-0.52	0.07	0.69	-0.38	0.17	0.55	-0.29	0.07	0.36
3	-0.05	0.74	-0.79	-0.06	0.38	0.44	0.64	0.76	0.12	-0.19	-0.14	0.05
4	0.17	0.40	0.23	0.57	0.36	-0.21	0.88	0.83	-0.05	0.19	-0.02	-0.12
5	0.33	0.26	-0.07	0.55	0.38	-0.17	-0.38	0.14	0.52	-0.54	-0.48	0.16
6	0.50	0.60	0.10	0.31	0.38	0.07	0.74	0.29	-0.45	-0.76	-0.88	-0.12
7	0.36	0.38	0.02	-0.57	-0.43	0.14	0.67	0.52	-0.15	0.05	0.05	0.00
8	-0.24	-0.29	-0.05	-0.55	-0.60	-0.05	0.05	-0.06	-0.11	0.81	0.45	-0.36
9	0.88	0.71	-0.17	0.95	0.76	-0.19	0.79	0.79	0.00	-0.62	-0.71	-0.09
10	-0.32	-0.10	0.22	-0.59	-0.48	0.11	-0.16	-0.06	0.10	0.10	0.05	-0.05
11	-0.48	-0.17	0.31	-0.43	-0.19	0.24	0.43	-0.40	-0.83	0.50	-0.17	-0.67
12	0.93	0.88	-0.05	0.93	0.98	0.05	-0.02	0.29	0.31	-0.69	-0.76	-0.07
13	0.03	0.36	0.33	0.45	0.57	0.12	0.63	0.64	0.01	0.03	-0.19	-0.21
14	0.74	0.79	0.05	0.21	0.45	0.24	0.19	0.43	0.24	-0.36	-0.33	0.03
15	0.00	0.55	0.55	0.19	-0.24	-0.43	0.29	0.21	-0.08	0.26	0.05	-0.21
16	0.83	0.71	-0.12	0.21	0.57	0.36	0.90	0.90	0.00	-0.95	-0.83	0.12
17	0.76	0.43	-0.33	0.45	0.33	-0.12	0.79	0.83	0.04	-0.43	0.02	0.45
18	0.48	0.88	0.40	0.29	0.90	0.61	0.57	0.74	0.17	0.40	-0.52	-0.92
19	0.02	0.83	0.81	0.81	0.86	0.05	0.86	0.60	-0.26	0.64	-0.05	-0.60
20	0.33	0.60	0.27	0.21	0.98	0.77	0.12	0.52	0.40	-0.43	-0.45	-0.02

	Rep. Grid 14			Rep. Grid 15		
	B	A	D	B	A	D
Subjects 1	-0.31	-0.21	0.10	-0.57	-0.86	-0.29
2	-0.48	-0.24	0.24	0.55	-0.06	-0.61
3	0.31	0.67	0.36	-0.38	-0.31	0.07
4	0.57	-0.02	-0.59	-0.83	-0.71	0.12
5	0.33	0.26	-0.07	0.10	0.02	-0.08
6	-0.40	-0.55	-0.15	-0.90	-0.76	0.14
7	-0.02	-0.10	-0.08	-0.52	-0.76	-0.24
8	0.33	-0.06	-0.39	-0.33	-0.05	0.28
9	0.62	0.17	-0.45	-0.21	-0.74	-0.53
10	-0.23	-0.33	-0.10	-0.61	-0.69	-0.08
11	0.50	-0.12	-0.62	-0.31	-0.33	-0.02
12	0.57	0.45	-0.12	-0.67	-0.88	-0.21
13	0.04	0.17	0.13	-0.95	-0.86	0.09
14	0.60	0.43	-0.17	-0.86	-0.29	0.57
15	0.43	0.14	-0.29	-0.55	-0.02	0.53
16	0.74	0.93	0.19	-0.45	-0.95	-0.50
17	0.60	0.86	0.26	-0.86	-0.62	0.24
18	0.74	0.83	0.09	-0.19	-0.60	-0.41
19	-0.50	0.83	1.33	-0.88	-0.71	0.71
20	0.45	0.64	0.19	-0.79	-0.81	-0.02

Note: B = Before
A = After
D = Difference

NOVICE MEDITATOR GROUP - PSYCHOLOGICAL TEST DATA

(Long-Term)

Subjects	Regularity Rating	Sex	Barber			Marlowe-Crowne			Taylor			EPI-N			EPI-E		
			B	A	D	B	A	D	B	A	D	B	A	D	B	A	D
1	3	F	9.5	1.5	-8.0	18	12	-6	11	13	2	9	12	3	7	6	1
2	7	M	2.5			9			39			17			8		
3	2	M	1.0	0.0	-1.0	9	7	-2	19	17	-2	15	14	-1	11	11	0
4	6	M	14.0			17			21			16			12		
5	6	F	9.5			18			8			13			20		
6	1	F	5.5	7.5	2.0	23	19	-4	7	8	1	4	2	-2	11	19	8
7	1	M	6.5	4.5	-2.0	5	6	1	11	8	-3	6	8	-2	16	17	1
8	6	M	3.5			13			6			8			16		
9	5	M	1.5	2.0	0.5	16	18	2	5	5	0	6	2	-4	16	13	-3
10	5	F	2.0	0.0	-2.0	22	15	-7	18	24	6	11	12	1	17	18	1
11	2	M	9.0	13.0	4.0	9	4	-5	25	15	-10	18	14	-4	8	9	1
12	2	M	7.5	12.0	4.5	18	18	0	14	9	-5	10	10	0	7	16	9
13	2	M	7.0	0.0	-7.0	15	19	4	12	5	-7	7	5	-2	10	9	-1
14	1	F	2.0	1.5	-0.5	22	21	-1	38	10	-28	21	13	-8	8	11	3
15	1	M	0.5	9.0	8.5	14	23	9	10	11	1	7	7	0	4	8	4
16	7	M	1.0			21			25			11			12		
17	3	F	10.0	5.5	-4.5	14	14	0	14	22	8	13	7	4	10	16	6
18	7	F	16.0			13			16			8			14		
19	3	M	3.0	3.0	0.0	18	14	-4	22	20	-2	16	8	-8	19	14	-5
20	3	M	7.5	4.0	-3.5	20	19	-1	14	15	1	10	9	-1	11	11	0
21	6	M	10.0			11			39			24			6		
22	2	M	7.5	1.5	-6.0	10	21	11	16	10	-6	11	9	-2	14	18	4
23	4	F	8.0	3.0	-5.0	7	10	3	38	35	-3	20	14	-6	10	7	-3
24	2	M	1.5	0.0	-1.5	19	19	0	8	10	2	5	3	-2	16	13	-3
25	3	M	2.0	2.5	0.5	16	15	-1	17	25	8	10	16	6	10	14	4
26	4	M	7.0	11.0	4.0	7	9	2	43	36	-7	23	21	-2	10	9	-1
27	4	F	10.0	8.0	-2.0	16	16	0	21	8	-13	15	3	-12	18	9	-9
28	2	F	12.0	14.0	2.0	15	21	6	34	23	-11	19	10	-9	13	15	2
29	5	F	8.5	6.0	-2.5	14	8	-6	25	26	1	16	16	0	18	14	-4
30	3	M	3.0	2.0	-1.0	13	13	0	24	17	-7	13	13	0	7	7	0
31	6	M	10.0			12			30			19			10		
32	2	F	5.0	3.5	-1.5	13	11	-2	20	16	-4	12	10	-2	14	13	-1
33	6	M	7.5			18			34			23			11		
34	7	M	2.5			15			18			17			21		
35	3	F	8.5	5.5	-3.0	5	6	1	15	15	0	10	8	-2	11	12	1
36	1	M	8.0	4.5	-3.5	8	18	10	18	5	-13	13	3	-10	12	14	2
37	2	F	9.0	6.5	-2.5	15	13	-2	19	14	-5	17	11	-6	17	20	3
38	2	F	7.5	10.0	2.5	20	20	0	30	32	2	16	14	-2	15	17	2

Regularity Rating

- 1: Meditate twice per day, every day } Regular Med.
 2: Meditate mostly twice per day, sometimes once } Group
 3: Meditate sometimes once per day, mostly once
 4: Meditate mostly once per day, seldom skip more than 1 day } Irregular Meditator
 5: Meditate sometimes (more than 4 times per week) } Group
 6: Meditate three times per week or less
 7: Not re-tested for variety of reasons

Notes:

- B = Before
 A = After
 D = Difference

(Long-Term)

		Rep. Grid 1			Rep. Grid 2			Rep. Grid 3		
		B	A	D	B	A	D	B	A	D
Subjects	1	-.26	-.57	-0.31	-.26	-.62	-0.36	.05	.40	0.35
	2	-.76			-.62			.88		
	3	.43	.10	-0.33	-.19	-.24	-0.05	-.52	-.38	0.14
	4	-.40			-.43			.29		
	5	-.52			-.31			.40		
	6	-.14	-.40	-0.26	-.43	-.50	-0.07	-.83	-.36	0.47
	7	-.31	-.57	-0.26	-.88	-.98	-0.10	.43	-.19	-0.62
	8	-.50			-.50			.50		
	9	-.26	-.45	-0.19	-.76	-1.00	-0.24	.79	.71	-0.08
	10	-.33	.36	0.69	-.52	-.21	0.31	.29	-.21	-0.50
	11	.29	.64	0.35	.05	-.52	-0.57	-.60	-.05	0.55
	12	.21	-.79	-1.00	-.43	-.50	-0.07	.45	.14	-0.31
	13	-.76	-.74	0.02	-.62	-.67	-0.05	.79	-.17	-0.96
	14	-.86	-.74	0.12	-.93	-.83	0.10	.90	.76	-0.14
	15	-.69	-.10	0.59	-.64	-.52	0.12	.31	-.38	-0.69
	16	.64			.24			-.36		
	17	-.57	-.24	0.33	-.81	.50	1.31	.88	.74	-0.14
	18	-.19			-.76			-.40		
	19	-.55	-.48	0.07	-.57	-.83	-0.26	.02	.90	0.88
	20	-.36	-.29	0.07	-.88	-.45	0.43	.00	.60	0.60
	21	-.19			-.29			-.19		
	22	-.60	-.71	-0.11	.12	-.06	-0.18	-.64	.38	1.62
	23	-.55	-.88	-0.33	.45	-.79	-1.24	.60	.88	0.28
	24	-.76	-.14	0.62	-.40	-.62	-0.22	.10	-.05	-0.15
	25	-.93	-.14	0.79	-.83	-.69	0.14	.86	.52	-0.34
	26	.43	-.14	-0.57	-.45	-.31	0.14	-.57	-.14	0.43
	27	-.71	-.33	0.38	-.86	-.36	0.50	.98	.19	-0.79
	28	-.12	.14	0.26	-.52	-.71	-0.19	-.14	.07	0.21
	29	.71	.29	-0.42	-.67	-.76	-0.09	-.31	-.19	0.12
	30	-.95	.00	0.95	-.69	-.40	0.29	.74	.05	-0.69
	31	-.69			-.71			.55		
	32	.17	.60	0.43	-.33	-.40	-0.07	-.24	-.31	-0.07
	33	.10			-.60			.62		
	34	-.45			-.52			.26		
	35	.50	.48	-0.02	.71	-.40	-1.11	-.86	-.52	0.34
	36	-.55	-.67	-0.12	-.67	-.98	-0.31	-.83	-.83	0.00
	37	-.93	-.64	0.29	-.83	-.88	-0.05	.29	.24	-0.05
	38	.26	-.74	-1.00	-.14	.33	0.47	-.17	-.26	-0.09

		Rep. Grid 4			Rep. Grid 5			Rep. Grid 6		
		B	A	D	B	A	D	B	A	D
Subjects	1	-.02	.60	0.62	.14	-.31	-0.45	.38	.33	-0.05
	2	.67			-.26			.90		
	3	.79	.64	-0.15	.17	-.38	-0.55	.74	.40	-0.34
	4	.57			.26			-.36		
	5	.64			.62			.07		
	6	.88	.48	-0.40	-.31	-.76	-0.45	.76	.81	0.05
	7	.48	.24	-0.24	.00	-.31	-0.31	.38	.90	0.52
	8	.50			-.19			.71		
	9	.71	-.57	-1.28	-.86	-.45	0.41	.26	.83	0.57
	10	.38	.36	-0.02	-.24	-.26	-0.02	.19	.07	-0.12
	11	.48	.10	-0.38	-.24	-.50	-0.26	-.40	.14	0.54
	12	.33	.52	0.19	.14	-.17	-0.31	-.64	.17	0.81
	13	-.60	-.19	0.41	.33	-.52	-0.85	-.29	.52	0.81
	14	.83	.95	0.12	-.86	-.81	0.05	.48	.98	0.50
	15	.76	.21	-0.55	-.14	-.67	-0.53	.43	.69	0.26
	16	-.36			.64			-.86		
	17	.90	.33	-0.57	.36	.36	0.00	.64	-.19	-0.83
	18	.00			-.45			.24		
	19	.74	.98	0.24	-.06	-.10	-0.04	-.74	.05	0.79
	20	.02	.50	0.48	-.36	-.38	-0.02	.93	.60	-0.33
	21	.64			.02			.43		
	22	.86	.38	-0.48	.52	.50	-0.02	-.67	-.43	0.24
	23	.52	.79	0.27	.57	-.74	-1.31	-.67	.74	1.41
	24	.69	.00	-0.69	.62	-.52	-1.14	.81	.48	-0.33
	25	.71	1.00	0.29	-.38	-.48	-0.10	.48	.60	0.12
	26	-.10	-.81	-0.71	.55	-.12	-0.67	.45	-.55	-1.00
	27	.50	.43	-0.07	-.69	.19	0.88	.38	-.12	-0.50
	28	.67	.00	-0.67	-.14	.05	0.19	.29	.00	-0.29
	29	.40	-.10	-0.50	.29	.02	-0.27	.33	.48	0.15
	30	.19	-.05	-0.24	-.45	.02	0.47	-.36	-.05	0.31
	31	.88			-.83			.48		
	32	.43	.24	-0.19	.45	.00	-0.45	.10	.24	0.14
	33	-.86			.40			-.17		
	34	.79			.33			.10		
	35	-.31	.21	0.52	.67	-.33	-1.00	.12	.48	0.36
	36	.95	-.90	-1.85	.71	.55	-0.16	.86	-.76	-1.62
	37	.88	.90	0.02	-.88	.12	1.00	.93	.36	-0.57
	38	.81	.00	-0.81	-.10	-.67	-0.57	.48	-.10	-0.58

Note: B = Before
A = After
D = Difference

(Long-Term)

H

		Rep. Grid 7			Rep. Grid 8			Rep. Grid 10		
		B	A	D	B	A	D	B	A	D
Subjects	1	.29	.57	0.28	.17	.86	0.69	.55	.19	-0.36
	2	-.55			-.10			-.24		
	3	-.29	.05	0.34	.05	-.02	-0.07	.36	.26	-0.10
	4	.02			.21			.12		
	5	-.12			.62			.24		
	6	.07	.21	0.14	-.02	.17	0.19	.19	-.60	-0.79
	7	-.33	.19	0.52	.50	.24	-0.26	.10	.81	0.71
	8	.29			.12			.71		
	9	.43	.21	-0.22	.33	.55	0.22	.31	.24	-0.07
	10	-.05	-.48	-0.43	-.10	.10	0.20	.24	-.14	-0.38
	11	.07	.52	0.45	.02	-.10	-0.12	.36	.69	0.33
	12	-.05	.38	0.43	.79	.74	-0.05	.36	.05	-0.31
	13	-.17	.48	0.65	.33	.31	-0.02	-.14	.64	0.78
	14	.83	.90	0.07	.90	.83	-0.07	.50	.86	0.36
	15	.43	-.48	-0.91	.55	-.12	-0.67	.48	.40	-0.08
	16	-.38			-.38			-.64		
	17	-.02	.71	0.73	.67	.88	0.21	.21	.52	0.31
	18	.17			.38			.62		
	19	.14	.90	0.76	.88	.83	-0.05	-.48	-.90	-0.42
	20	.00	.00	0.00	.60	.33	-0.27	-.10	.33	0.43
	21	-.31			.50			-.43		
	22	.57	.67	0.10	.88	.76	-0.12	-.33	-.21	0.12
	23	-.81	.95	1.76	.55	.88	0.33	-.69	.60	1.29
	24	.50	.24	-0.26	.74	.48	-0.26	.76	.60	-0.16
	25	.88	.86	-0.02	.52	.76	0.24	.62	.36	-0.26
	26	.31	.33	0.02	.57	-.26	-0.83	.55	.79	0.24
	27	.81	.19	-0.62	.19	.43	0.24	.02	.24	0.22
	28	-.14	.12	0.26	.19	.14	-0.05	.55	.17	-0.38
	29	-.10	.67	0.77	.74	.52	-0.22	.43	.93	0.50
	30	.33	.19	-0.14	.69	-.10	-0.79	.60	.12	-0.48
	31	.90			.81			.69		
	32	-.06	-.14	-0.08	.43	.74	0.31	.14	.55	0.41
	33	.00			.52			-.17		
	34	.33			.48			.02		
	35	-.71	.12	0.93	.21	.40	0.19	-.21	.43	0.64
	36	.98	1.00	0.02	.81	.95	0.14	.64	.52	-0.12
	37	.83	.19	-0.64	.93	.90	-0.03	.71	.69	-0.62
	38	.52	.24	-0.28	.26	.64	0.38	.21	.38	0.17

		Rep. Grid 11			Rep. Grid 12			Rep. Grid 13			Rep. Grid 14			Rep. Grid 15		
		B	A	D	B	A	D	B	A	D	B	A	D	B	A	D
Subjects	1	-.00	-.57	0.57	.62	.48	-0.14	-.17	-.60	-0.43	-.05	-.36	-0.31	-.48	-.48	0.00
	2	-.74			.69			-.17			-.33			-.36		
	3	.48	.24	-0.24	.64	.64	0.00	.40	.05	-0.35	.24	.10	-0.14	-.14	.24	0.38
	4	-.10			.36			-.24			.02			-.48		
	5	-.60			.31			-.88			-.19			-.62		
	6	.26	.74	0.45	.10	.24	0.14	.07	.38	0.31	.05	-.02	-0.07	-.36	-.45	-0.09
	7	.26	-.38	-0.64	.57	.76	0.19	.17	.24	0.07	-.33	.10	0.43	-.62	.07	0.69
	8	.62			-.55			-.10			.10			.00		
	9	.19	.12	-0.07	-.05	.45	0.50	-.52	-.71	-0.19	.71	.12	-0.59	-.81	-.81	0.00
	10	-.19	-.31	-0.12	.67	.64	-0.03	-.52	.31	0.83	.60	-.83	-1.43	-.29	-.60	-0.31
	11	-.14	-.24	-0.10	.40	.50	0.10	.05	.02	-0.03	-.38	-.19	0.19	-.19	.57	0.76
	12	.38	.48	0.10	-.06	.21	0.27	-.38	.05	0.43	-.21	.48	0.69	-.17	-.69	-0.52
	13	-.12	.64	0.76	.36	.21	-0.15	-.26	-.38	-0.12	-.29	.07	0.36	-.57	-.10	0.47
	14	.48	.69	0.21	.57	.90	0.33	-.95	-.79	0.16	.86	.88	0.02	-.71	-.95	-0.24
	15	-.12	.02	0.14	.60	.57	-0.03	-.43	-.05	0.38	.26	.10	-0.16	-.60	-.55	00.05
	16	-.06			-.64			.14			-.81			.24		
	17	.70	.17	-0.59	.50	.62	0.12	.83	.62	-0.21	.55	.17	-0.38	-.64	-.74	-0.10
	18	.83			.10			.21			.62			-.02		
	19	-.10	-.43	-0.33	.71	.98	0.27	-.48	-.57	-0.09	-.17	.38	0.55	-.64	.33	0.97
	20	-.17	.00	0.17	.57	.48	-0.09	.29	.26	-0.03	-.43	.10	0.53	-.52	-.36	0.16
	21	-.29			.14			-.06			-.79			-.86		
	22	.43	-.29	-0.72	-.19	-.26	-0.07	-.57	.24	0.81	-.02	-.62	-0.60	.05	.19	0.14
	23	-.69	.57	1.26	.07	.57	0.50	.07	-.76	-0.83	-.69	-.90	-0.21	.00	-.98	-0.98
	24	.71	.67	-0.04	.71	.88	0.17	-.19	-.81	-0.62	.64	.69	0.05	-.76	-.02	0.74
	25	.33	.19	-0.14	.45	.52	0.07	-.90	-.71	0.19	.05	.38	0.33	.57	.67	0.10
	26	.45	.33	-0.12	-.81	-.38	0.43	-.43	.21	0.64	.07	.26	0.19	.00	.57	0.57
	27	.19	.17	-0.02	.33	-.14	-0.47	-.76	-.33	0.43	.60	-.74	-1.34	-.33	-.19	0.14
	28	.40	.64	0.24	.12	.33	0.21	.02	-.26	-0.38	.05	.33	0.28	-.69	-.52	0.17
	29	.07	.33	0.26	.50	.12	-0.38	-.33	-.74	-0.41	-.48	.36	0.84	-.38	.07	0.45
	30	-.33	-.14	0.19	.62	.79	0.17	-.10	.19	0.29	.43	-.48	-0.91	-.40	-.67	-0.27
	31	.62			.81			-.14			.52			-.52		
	32	.48	.33	-0.15	.69	.52	-0.17	-.12	-.26	-0.14	-.31	.21	0.52	-.29	-.52	-0.23
	33	-.24			.33			.31			-.33			-.43		
	34	.52			.52			-.33			.17			-.76		
	35	-.06	.48	0.54	-.45	-.24	0.21	.45	.26	-0.19	-.31	-.12	0.19	.55	-.26	-0.81
	36	.57	.74	0.17	.62	.79	0.17	.93	-1.00	-1.93	.40	.57	0.17	-.74	-.93	-0.19
	37	.74	.86	0.12	.81	.19	-0.62	.02	-.74	-0.76	.50	.74	0.24	-.43	-.36	0.07
	38	.21	.24	0.03	-.29	-.36	-0.07	.26	-.24	-0.50	-.71	-.55	0.16	-.38	.12	0.50

Note: B = Before
A = After
D = Difference

ALPHA FEEDBACK GROUP - PHENOMENOLOGICAL REPERTORY GRID DATA

(Short-Term)

Constructs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Subjects 3	.79	-.45	-.45	-.45	-.48	-.57	-.43	-.64	0.50	-.55	.71	-.83	.86	-.90	.90	.93	-.98
4	.90	-.86	-.79	-.76	-.71	-.62	-1	.81	.76	-.71	.90	-.67	.57	-.10	-.83	.71	-.79
6	1	1	-.69	-.69	-.69	-.69	-.69	1	-.69	-.69	1	-.69	1	-.69	-.69	1	-.69
9	.90	-.98	.98	-.98	-.98	-.86	-.95	.93	1	-.95	.90	-.71	-.76	1	-1.0	1	1
10	.19	.60	.14	-.36	-.33	-.14	.19	-.12	-.31	-.02	.19	-.12	.33	-.57	.10	.33	-.26
12	-.57	-.64	-.62	-1.0	-.93	-1.0	-1.0	.38	.71	-1.0	-.57	-.86	.83	.60	-.64	1	.74
13	.68	-.67	-.21	-.45	-.90	-.62	-.95	.56	.40	-.64	.83	.95	.76	-.33	-.93	-.95	-.52
15	.31	-.29	.19	-.12	-.81	-.29	.29	.02	-.14	.48	-.38	-.21	.43	-.38	.29	-.06	
16	.88	-.86	.83	-.86	-.76	-.93	-.98	.95	.95	-.60	.88	.71	.02	-.38	.81	.43	.43
19	.74	-.64	.74	-.98	-.90	-.98	-.88	.69	.67	-.74	.74	-.69	.74	.52	-.74	.71	.71
20	-.02	-.21	.36	-.06	-.02	-.06	-.76	-.12	.45	-.40	.12	.62	.02	-.17	-.48	.69	.69

Constructs	18	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34	35	36
Subjects 3	-.98	.98	1.00	-.98	.98	1.00	.95	.93	.93	.90	-.86	.98	-.88	-.95	-.93	-.98	.98	-.99
4	.81	.60	.90	-.81	.67	.83	.71	.81	-.83	.83	.76	.71	-.67	.74	-.93	-.83	-.83	-.10
6	1	1	1	-.69	1	1	1	1	-.69	1	-.93	1	-.69	-.69	-.69	-.69	-.69	-.69
9	-1.0	-1.0	-1.0	-.93	.71	1	.98	.86	-.86	.95	-1.0	1	-1.0	-.98	-.90	-.90	.90	-.98
10	-.50	.48	.48	-.48	-.17	.48	.19	.48	.48	.05	-.50	.45	.64	-.31	-.48	-.31	.45	.02
12	-.79	.81	-.81	.81	1	1	.93	1	.93	.90	1	1	-.86	-.98	-.60	-.86	1	-.62
13	-.95	.79	.76	-.86	.93	.95	.86	.81	.12	.60	-.38	.93	.93	-.88	.93	-.88	.76	-.93
15	-.43	.17	-.19	.24	-.64	.24	.55	-.79	-.48	-.26	.69	.60	.76	-.86	.86	-.57	-.93	.95
16	-.71	.40	.90	-.88	-.19	.24	.76	.90	.86	.71	.95	.43	-.76	-.40	-.88	-.79	.86	-.74
19	-.64	.98	.74	-.69	.69	.98	.90	.74	.52	.74	.67	.86	-.69	-.83	-.74	-.83	.52	-.83
20	-.36	-.36	-.36	-.57	.83	.24	.02	.40	-.19	-.24	.45	.38	.76	-.93	.57	-.43	.55	-.12

These Ss correspond to the "successful" alpha feedback sub-group as defined by "the experimenter's rating" criterion.

ADVANCED MEDITATOR GROUP - PHENOMENOLOGICAL REPERTORY GRID DATA

(Short-Term)

Constructs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Subjects 1	-.10	.31	.83	.29	-.24	.24	-.05	-.62	.29	.33	-.19	-.21	.29	.26	.24	.05	-.19	-.21
2																		
3	.31	-.24	-.24	-.26	-.29	-.67	-1	.31	.12	-.40	.26	-.48	.31	.05	.05	.31	-.26	-.48
4	.62	-.36	-.55	-.64	-.69	-.81	-.69	.88	.40	-.71	.64	-.57	.86	.90	-.45	.83	-.90	-.76
5	.19	.19	.19	-.45	-.19	.19	.19	-.45	-.45	-.45	.19	-.45	.19	.19	-.45	.19	-.45	-.45
6	-.10	.45	-.14	0.00	-.21	-.21	-.21	.21	-.21	-.21	.21	-.21	.21	-.60	-.21	.21	-.21	-.21
7																		
8	.45	-.26	.55	.48	-.24	-.29	-.55	.26	.43	-.52	.45	-.40	.17	.55	-.86	.55	-.79	-.55
9	.90	.90	.90	-.90	-.38	.90	-.90	.17	0.00	-.90	.90	-.90	.90	.90	-.90	.90	-.90	-.90
10	.52	.29	.29	-.38	-.40	-.31	.24	.52	-.45	-.64	.52	-.52	.52	-.52	-.43	.52	-.36	-.29

Constructs	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34	35	36
Subjects 1	-.33	.24	-.19	.24	.24	.24	-.33	.24	.19	-.12	.12	.17	.05	.05	0.00	.05	-.19
2																	
3	.26	.31	-.48	.48	.31	.29	.31	.60	-.31	.31	.31	-.05	0.5	-.31	-.33	.60	-.26
4	.93	.90	-.86	.76	.81	.76	.67	-.02	.74	-.17	.90	-.33	-.50	-.86	-.67	-.02	-.36
5	-.45	.19	-.45	-.45	.19	.45	.19	.19	.19	-.45	.19	.19	-.45	-.45	-.45	.19	.19
6	.21	.21	-.21	.21	-.21	.45	.21	.21	.48	-.21	.21	-.21	-.52	-.21	-.21	-.33	.24
7																	
8	.10	.10	-.55	.14	.50	.50	.10	.43	.62	-.74	.48	-.10	.31	-.95	-.55	-.71	.40
9	.90	.90	-.40	.90	.90	.12	.90	.69	.90	0.00	.90	-.90	.90	-.90	-.90	.62	.90
10	-.48	.52	-.12	.55	.36	.52	.40	-.83	.50	.29	.55	-.48	-.57	-.57	-.57	-.71	.48

ALPHA FEEDBACK GROUP
DIFFERENTIAL ALPHA CONTROL DATA

Ss	Alpha				Beta				High Alpha				Low Alpha			
	Before		After		Before		After		Before		After		Before		After	
	E	S	E	S	E	S	E	S	E	S	E	S	E	S	E	S
1	13	38	16	4	49	68	66	97	11	12	0	0	0	0	0	0
2	120	77	155	63	3	49	3	60	1	5	3	5	28	11	51	9
3	16	28	158	8	15	25	2	33	1	5	92	3	0	0	0	0
4	33	119	108	99	28	8	18	13	20	49	40	10	0	19	4	0
5	53	10	32	9	59	74	63	71	11	2	1	0	0	0	0	0
6	0	0	0	3	16	13	29	17	0	0	1	0	0	0	0	0
7	50	75	52	32	21	11	15	20	29	59	11	24	1	1	0	0
8	11	2	3	13	76	89	71	79	0	1	3	0	0	0	1	0
9	35	73	92	55	12	13	5	14	28	38	31	10	2	0	0	2
10	69	62	32	27	4	12	10	20	16	11	0	12	0	0	1	0
11	15	6	25	29	27	29	32	30	10	14	3	0	0	0	0	2
12	27	6	111	79	12	20	9	19	0	3	6	3	0	0	3	2
13	122	141	157	119	0	0	2	3	0	3	0	0	43	18	52	19
14	116	105	75	39	11	7	17	30	89	49	17	13	0	0	0	0
15	138	121	78	16	0	1	16	28	56	67	42	12	0	0	0	4
16	0	8	8	0	49	59	76	36	0	1	2	0	0	0	0	0
17	0	0	10	0	87	96	74	48	0	0	0	0	0	0	0	0
18	23	13	136	111	41	27	0	7	17	2	51	66	0	0	2	0
19	116	127	45	12	3	1	21	40	21	58	0	4	2	0	3	0
20	84	90	139	52	2	2	7	6	1	11	8	8	8	5	2	3

E = Enhance
S = Suppress

THE REPERTORY GRIDS EMPLOYED

REPERTORY GRID TEST

Subject's Name Sex
 Age Address
 Phone Numbers
 Experimenter's Name Date
 Experimental Procedure

ROLE TITLE LIST

Instructions

Write the names of each of the persons indicated in the blanks provided below.

If you cannot remember the name, but do remember the person, simply make a check or mark of some other note of identification.

If you cannot remember the person, substitute the name of a person whom the role title suggests to you.

Do not repeat names. If the role title appears to call for a duplicate name, substitute the name of another person whom the second role title suggests to you.

1. Your brother nearest your age. If you have no brother, the person who is most like one.
2. Your sister nearest your age. If you have no sister, the person who is most like one.
3. A teacher you liked or a teacher of a subject you liked
4. A teacher you disliked or a teacher of a subject you disliked.
5. Your closest girl (boy) friend immediately before you started going out with your wife (or husband) or present closest girl (boy) friend.
6. Your wife (or husband) or present closest girl (boy) friend
7. The person whom you have met within the past six months whom you would most like to know better
8. The most intelligent person whom you personally know.

K

Subject's Name Sex
 Age Address
 Phone Numbers

Experimenter's Name Date
 Experimental Procedure

Instructions

Rank-order each of the eight persons you listed on the Role Title List against each of the fifteen dimensions given below.

In each case, instead of writing the persons name, substitute his or her number as given on the Role Title List.

1. Tense	.....	Relaxed
2. Least like I would like to be	.....	Most like I would like to be
3. Most frustration toleration	.....	Least frustration toleration
4. Empathic	.....	Non-empathic
5. Least able to concentrate	.....	Most able to concentrate
6. Involved	.....	Apathetic
7. Happy	.....	Unhappy
8. Most like I am	.....	Least like I am
9. Warm	.....	Cold
10. Active	.....	Passive
11. Outgoing	.....	Withdrawn
12. Creative	.....	Sterile
13. Pessimistic	.....	Optimistic
14. Most confident	.....	Least confident
15. Insensitive	.....	Sensitive

STRUCTURED PHENOMENOLOGICAL REPERTORY GRID

Subject's Name Sex
 Age Address
 Phone Numbers

Experimenter's Name Date
 Experimental Procedure

Instructions

Rank-order each of the 8 persons you listed on the Role Title List against each of the 36 dimensions given below.

In each case, rank these persons according to how you would guess they would feel or behave in the present, rather limited, context.

Also, instead of writing the person's name, substitute his or her number as given on the Role Title List.

1. Has most breath slowing	.....	Has least breath slowing
2. Experiences least visualisation	.....	Experiences most visualisation
3. Experiences least heaviness	.....	Experiences most heaviness
4. Finds it most harmful	.....	Finds it least harmful
5. Experiences least time slowing	.....	Experiences most time slowing
6. Finds it most anxiety evoking	.....	Finds it least anxiety evoking
7. Experiences and behaves least like I would wish to	.....	Experiences and behaves most like I would wish to
8. Experiences least heart-rate speeding	.....	Experiences most heart-rate speeding
9. Has most active experience	.....	Has least active experience
10. Finds it least physically relaxing	.....	Finds it most physically relaxing

K

11.	Experiences most breath slowing	Experiences least breath slowing
12.	Experiences greatest outward attention shift	Experiences least outward attention shift
13.	Has least eye-movements	Has most eye-movements
14.	Finds it least sleep inducing	Finds it most sleep inducing
15.	Becomes least aware of internal stimuli	Becomes most aware of internal stimuli
16.	Finds it most pleasant	Finds it least pleasant
17.	Experiences most thoughts	Experiences least thoughts
18.	Experiences least lightness	Experiences most lightness
19.	Finds it most anxiety reducing	Finds it least anxiety reducing
20.	Experiences most breath shallowing	Experiences least breath shallowing
21.	Experiences least heart-rate slowing	Experiences most heart-rate slowing
22.	Experiences most inward attention shift	Experiences least inward attention shift
23.	Experiences and behaves most like I do.	Experiences and behaves least like I do.
24.	Finds it most beneficial	Finds it least beneficial
25.	Experiences most time speeding	Experiences least time speeding
26.	Finds it least physically tensing	Finds it most physically tensing
27.	Experiences least cold	Experiences most cold
28.	Has least physical movement	Has most physical movement
29.	Has least passive experience	Has most passive experience
30.	Finds it least unpleasant	Finds it most unpleasant
31.	Becomes most aware of external stimuli	Becomes least aware of external stimuli
32.	Has lowest alpha levels	Has highest alpha levels
33.	Experiences most breath speeding	Experiences least breath speeding
34.	Has least floating experiences	Has most floating experiences
35.	Experiences most warmth	Experiences least warmth
36.	Experiences least loss of consciousness	Experiences most loss of consciousness

APPENDIX L

Skinner's Alternative Explanation for Apparent Operant Autonomic Response
Conditioning

Skinner accepted that humans can and do exert control over autonomic responses. He denied, however, that this control was direct. He asserted instead that the control was chained to a mediating voluntary operant and that operant autonomic response conditioning was thus an epiphenomenon. Katkin and Murray (1968) summarised Skinner's (1938) description of the four ways in which such apparent operant autonomic response conditioning can occur:

- (1) An autonomic response may be an unconditioned response to an external source of stimulation. For example, reinforcement contingent upon a GSR change could result in, not a direct conditioning of the GSR, but rather a skeletal maneuver, such as pinching the skin which could mediate the reinforced autonomic change.
- (2) An autonomic response may be an unconditioned response to an internal source of stimulation. For instance, reinforcement contingent upon a GSR change may result in, not a direct conditioning of the GSR, but rather an internal somatic maneuver such as increased muscular activity which could mediate the reinforced autonomic change.
- (3) An autonomic response may be a conditioned response to an external source of stimulation. That is, reinforcement contingent upon a particular ANS change may result in, not a direct conditioning of this ANS change, but rather some other somatic response, such as looking at an arousing picture of which this ANS change is a conditioned response, which may then mediate the reinforced ANS alteration.
- (4) An autonomic response may be a conditioned response to an internal source of stimulation. That is, reinforcement contingent upon a particular ANS change may result in, not a direct conditioning of this ANS change, but rather some internal sub-vocal activity (i.e., thinking), such as thinking arousing thoughts, of which this ANS change is a conditioned response, which may then mediate the reinforced ANS alteration.

APPENDIX M

Validity and Reliability of the EEG Spectrum Analysis Unit

100-second EEG samples of 10 subjects were analysed by means of the EEG Spectrum Analysis Unit (see section 5.2.1) to give a numerical readout in terms of percentage time alpha, beta, high alpha and low alpha. These data are shown in the Table below. In addition, 10 corresponding 100-second EEG paper-record samples were obtained at a chart-speed of 10mm/sec. They were subsequently subjected "blind" to visual analysis in terms of percentage time alpha, beta, high alpha and low alpha. These data are also displayed below.

Ss	Percentage Time Alpha		Percentage Time Beta	
	Unit Analysis	Visual Analysis	Unit Analysis	Visual Analysis
1	46	40	3	7
2	36	31	10	17
3	20	27	33	24
4	0	4	11	16
5	36	32	2	8
6	22	27	1	5
7	68	60	1	3
8	2	7	36	32
9	42	34	4	8
10	56	47	1	4

Ss	Percentage Time High Alpha		Percentage Time Low Alpha	
	Unit Analysis	Visual Analysis	Unit Analysis	Visual Analysis
1	39	29	0	2
2	16	22	10	5
3	3	6	1	3
4	10	5	5	0
5	12	19	7	2
6	4	8	1	3
7	1	3	25	34
8	9	6	8	2
9	4	8	3	5
10	8	4	17	8

The two forms of EEG analysis were compared over each of the 4 EEG frequency bands. That is, Pearson correlations were calculated for the scores of the subjects as determined by the two analysis techniques (Roscoe, 1969, p. 71).

Alpha : $r = 0,9826$

Beta : $r = 0,9581$

High Alpha : $r = 0,8633$

Low Alpha : $r = 0,8340$

In order/

In order to establish the reliability or stability over time of the EEG Spectrum Analysis Unit, it was tested on a number of occasions by means of a Hewlett-Packard function generator. At no stage was a discernable alteration in frequency response found. The unit appeared therefore to have been highly stable over the period during which it was in use.

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