ELECTROENCEPHALOGRAPHIC ALPHA, SKIN CONDUCTANCE AND HYPNOTIC CAPABILITY

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ABSTRACT

On the basis of alternative theories it was hypothesized that hypnotizability could be meaningfully enhanced by Antarctic isolation and laboratory controlled sensory deprivation. The research also sought to test Reyher's (1964) psychophysiological theory of brain function in contrast to E.R. Hilgard's (1976, 1977) neo-dissociation interpretation of hypnosis combined with J.R. Hilgard's (1974, 1979) imaginative involvement findings. An additional purpose was to determine the relationship between EEG alpha density and hypnotizability while controlling for electrodermal arousal. Eight channels of EEG, bipolar skin conductance (SC) and hypnotizability data were collected in Antarctica before and after wintering-over isolation. Ss showed significant increases in hypnotizability and EEG alpha densities following wintering-over isolation. No significant correlation was found between EEG alpha and hypnotizability prior to isolation, but this correlation approached significance following isolation. Correction of EEG records using SC indices of arousal resulted in a significant correlation between EEG alpha and hypnotizability following isolation. In another investigation laboratory controlled sensory deprivation (SD) procedures were used with 10 Ss. The Stanford Hypnotic Clinical Scale (SHCS), a post-hypnotic suggestion for analgesia and pain threshold and tolerance tests were administered prior to SD, immediately after and 10-14 days later. EEG, SC, peripheral, core and chamber temperature data were collected prior to, during and after SD. A control group of 10 Ss was used to assess the effects of repeated hypnosis upon susceptibility scores (plateau effects) and demand characteristics. SD subjects showed significant and dramatic increases in SHCS scores and pain tolerance after SD which was maintained at follow-up testing. These increases were also significant in contrast to control Ss who failed to show significant changes in SHCS or pain measures. The first use of Orne's (1959) post experimental inquiry in such a study did not reveal demand characteristics that might account for results. The maintenance of hypnotizability and pain tolerance at follow-up failed to support Reyher's (1964) theory but was consistent with E. R. Hilgard (1977) and J. R. Hilgard (1974, 1979). Consistent with general EEG-sensory/perceptual deprivation/restriction research and the Antarctic study above EEG alpha densities increased significantly following deprivation, but mid- SD alpha densities were significantly lower than pre- or post- SD levels. Average SD skin conductance levels increased markedly from pre- tomid- SD and then returned to pre- SD levels. The potential of using such psychophysiological measures to determine SD exposure times for maximal hypnotizability enhancement is discussed.

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INTRODUCTION

Statement of the Problem

The relatively low percentage of highly hypnotizable or susceptible persons in the general population is a major problem in clinical and research applications of hypnosis. The utility of hypnosis in psychotherapy, modification of behaviour, and in the relief of pain is dependent on the individual's ability to respond to hypnotic techniques. The susceptibility obstacle has been the focus of numerous investigations in recent years. The literature can be divided into those studies that support the notion that susceptibility exists as a stable trait within subjects and those that claim that it is a modifiable trait.

Several studies have shown hypnotic susceptibility to be a stable trait. These studies report high test-retest reliability of hypnotizability scores using both the same and different hypnotists. They also show that there are high positive correlations between the various hypnotizability tests, even though the tests use diverse induction procedures and test items.

Alternatively, hypnosis has been conceptualized as modifiable and a wide range of enhancement techniques have been attempted. Studies purporting to modify susceptibility have produced statistically significant increases on standardized tests of hypnotizability, but these changes have been rather disappointing and trivial in terms of practical implications. The conclusions drawn are frequently more favourable to modifiability than the data upon which they are based. Several major methodological problems are apparent. Modification studies have failed to control for or consider one or more of the following: (1) generalization data beyond that of hypnotic susceptibility test scores, (2) follow-up testing, (3) plateau hypnotizability (Shor, Orne & O'Connell, 1962), (4) situational factors e.g. positive/negative motivational instructions, or (5) demand characteristics e.g. cues in the design and/or procedure which might communicate the experimenter's hypothesis and lead the subject to provide data confirming the experimenter's predictions (Orne, 1959).

The existence of numerous valid criticisms of modification studies does not mean that hypnotizability cannot be meaningfully enhanced in terms of durable generalization to criterion measures. Independently of the hypnosis literature, sensory deprivation research has consistently shown increases in responsivenss to suggestion (Zubek, 1969, 1973). Such responsiveness might relate to hypnotic performance and it points toward the potential utility of deprivation procedures in the enhancement of hypnotizability.

Sensory deprivation, EEG and hypnotizability - Engstrom (1976) suggested that the restriction of sensory experience may be a variable basic to hypnosis. He noted that the "skills involved in becoming hypnotized may include a subject's predisposition to restrict sensory input because of lower levels of cortical arousal."

The slowing of electroencephalographic (EEG) activity was reported in several of the investigations cited in Zubek's (1973) review of the effects of prolonged sensory and perceptual deprivation. EEG slowing can occur in deprivation periods as short as 1 hour (Marjerrison & Keogh, 1967) and in environments providing social stimulation combined with sensory or perceptual restriction (Hinkle, 1961). The extent of alpha frequency slowing has been reliably shown to be dependent upon deprivation conditions. Restriction of sensory input to the subject apparently occurs in active-alert hypnotic induction (Banyai & Hilgard, 1976) where focused attention seems to be a common characteristic. It has been noted that although eyes remained open in the alert induction, the gaze appeared unfocused, as though the S was staring at some distant object. Ss reported the ability to "...tune things around me out...". Hilgard and Hilgard (1975, p.11) found that "imaginative involvements" developed in childhood relate to high hypnotizability. This finding was viewed to be consistent with studies of brain function showing a positive correlation between EEG alpha and hypnotizability.

Unfortunately, the relationship between subject's waking eyes closed EEG alpha density and hypnotizability is not a straightforward one. In contrast to the sensory deprivation influence on alpha EEG as reviewed by Zubek (1963, 1973) and Engstrom's (1976) suggestion that sensory restriction may be basic to hypnosis, Dumas (1977) suggested that subject self-selection according to the invitation to participate in hypnosis research might account for EEG-hypnotizability correlations. On the basis of a review of the literature, Dumas (1977) concluded that the only consistent covariate of the alpha-hypnotizability correlation was the method by which subjects were selected. In experiments where the sample consisted of non-naive volunteers there was a significant correlation, while investigations using invited subjects or subjects unaware of the experimental focus found no correlation. A correlation typically occurs when subjects volunteer for a "brainwave and hypnosis" study but no such relationship is apparent when subjects are drafted. It was concluded that subject self-selection, based on the invitation to participate voluntarily as opposed to the situation in which coercion is applied, is primarily responsible for alpha-hypnotizability correlations. Evaluation of EEG alpha and hypnotizability studies is also confounded by great inconsistencies in baseline techniques and electrode placements among investigations.

Alpha-hypnotizability studies have failed to consider the possible role of arousal and its potential effects on EEG alpha densities. Psychophysiological arousal, vigilance and even relatively simple cognitive tasks have been shown to be incompatible with alpha production (Enslein, Beatty, Grossberg, Cohen, Chapman, Videl & Rebert, 1975). Electrodermal response indices have been found to be negatively correlated with alpha production (Pelletier & Peper, 1977). It occurred to the present investigator that Dumas' (1977) consistent findings of no correlation between alpha and hypnotizability for naive or drafted subjects, might be accounted for by the suppression of Ss' typical eyes-closed alpha due to arousal. Crosson, Meinz, Laur, Williams and Andreychuk (1977) suggested that arousal responses in a novel environment, soon after Ss have electrodes attached, could block alpha activity. It could be expected that naive or invited subjects might demonstrate greater psychophysiological arousal during experimentation than informed volunteers.

Summary of the Problem

The low percentage of highly hypnotizable persons in the general population combined with the apparent stability of susceptibility is a major obstacle to the wider application of hypnosis. To date, modification investigations have produced relatively trivial effects and major methodological problems are apparent. The acknowledged validity of these criticisms does not mean that hypnosis cannot be meaningfully modified or that its general stability is unaffected by specific environmental factors. Independent of the hypnosis research, sensory restriction and deprivation studies have revealed increases in suggestibility, and a slowing of EEG dependent upon deprivation conditions. Restriction of sensory experience may be a variable basic to hypnosis. Hypnotic talent (hypnotizability) may involve the person's predisposition to restrict sensory input because of lower levels of cortical arousal. A number of studies have shown a correlation between EEG alpha density and hypnotizability but the finding has not been replicated with drafted subjects. The potential influence of autonomic arousal on EEG-hypnotizability correlations has not been studied. The variable of subject self selection according to invitation to hypnosis has not been considered on an *a priori* basis in hypnotizability-EEG research.

The primary purpose of the studies reported in this thesis is to determine whether or not hypnotic capability can be meaningfully modified by sensory restriction. An additional purpose is to determine the relationship between EEG alpha and hypnotizability while controlling for skin conductance measures of arousal with drafted subjects that are naive with respect to the experimental focus. Several specific questions seem apparent: Will waking eyes-closed EEG alpha and hypnotizability remain stable if drafted subjects, remaining unaware of the experimental focus, are exposed to a prolonged restriction of sensory and perceptual stimulation? Can alpha-hypnotizability correlations be enhanced by considering skin conductance measures of autonomic arousal in the evaluation of EEG records? Can demand characteristics and situational variables be controlled in a laboratory hypnotizability modification study using sensory deprivation procedures? If sensory deprivation procedures significantly enhance hypnotizability scores, will this effect generalize to meaningful criteria such as increased responsiveness to hypnotic suggestions for pain tolerance? Does plateau susceptibility account for enhancement results? Will increases in hypnotizability and pain tolerance be maintained in follow-up evaluations? What are the theoretical implications?

Theoretical Perspectives

Joseph Reyher - Reyher (1964) described a psychophysiological theory of brain function and behavioural regulation consistent with Herrick's (1956) conception of the nervous system and Livingston's (1957) work on the neurophysiology of the reticular formation. Reyher (1964) accepted the conception of the human brain as a "series of levels of progressively more complicated structural and functional organization." He suggested that "Although the functions of phylogenetically older structures have become transferred to more recent cortical structures by the process of encephalization and corticalization, the older structures have not ceased to function but are modified by them." It was noted that "different cortical fields can dominate or regulate mechanisms in the intact brain, depending upon the nature of the stimulating conditions." Livingston (1957) noted that different cortical fields may have wide regulatory control. One cortical field that is regnant when the organism is alert may be controlled by another cortical field when it is comparatively inattentive to environmental stimuli.

Reyher (1964) reasoned that hypnosis and sensory deprivation are manifestations of the ascendance of lower levels of neural integration in the organization of brain functions and behavioural regulation. Adaptive behaviour is viewed as a function of high neuronal integration. Conditions which eliminate or homogenize sensory input prevent adaptive behaviour with adaptive neuronal integration replaced by a phylogenetically older and lower level of integration. It was hypothesized that sensory deprivation or sensory restriction should then result in an increase in hypnotic susceptibility immediately following deprivation, Removal from deprivation reactivates adaptive behaviour and its supporting level of neuronal integration. This model would, therefore, predict a return to pre-deprivation hypnotizability scores in later follow-up testing.

In an attempt to test Reyher's (1964) theory Sanders and Reyher (1969) found significant increases in Stanford Hypnotic Susceptibility Scale (SHSS) (Weitzenhoffer & Hilgard, 1959) scores following six hours of sensory deprivation, or until clinical signs of deprivation, such as craving for stimulation, were evidenced.

The magnitude of the SHSS increases support this study as the most successful research attempt to modify hypnotic susceptibility. The findings were viewed as consistent with Reyher's (1964) model. The SHSS increases were, however, still present in a later follow-up, and this finding could not be accounted for by the theory. Unfortunately, the specific demand characteristics of the instructions combined with hypnosis-related situational variables could have accounted for the follow-up finding and/or the post test finding. The theory remains to be tested.

Ernest Hilgard - Hilgard (1976, 1977, 1979b) described a neo-dissociation interpretation of hypnosis which reintroduced and extended Janet's (1889) concept of dissociation in personality function. Hilgard (1979a) noted "Given a broad enough interpretation of dissociation as implying a loss of familiar associations, both of sensory systems and of motor control systems, most phenomena of hypnosis can be described as dissociative."

The loss of voluntary motor control and the shift from voluntary to involuntary control is common in hypnosis. Such shifts can be viewed as a dissociation of the usual control systems (Hilgard, 1963; Slotnick, Leibert & Hilgard, 1965; Slotnick & London, 1965). Post-hypnotic amnesia for the events occuring during hypnosis is a prominent feature of hypnosis. The memory retrieval processes are dissociated so the person is unable to remember what has just happened (Hilgard & Hommel, 1961; Clemes, 1964; Hilgard & Cooper, 1965; Cooper, 1966; Kihlstrom, 1979).

Hypnotic age regression illustrates dissociation by the recovery of unavailable memories and when the subject views a childhood scene as a hallucinated motion picture. Because the scene can be viewed as an adult there is clearly a dissociation between the childhood memories, projected as a movie, and the experiencing adult (Hilgard, 1979a). Dissociation is clearly exhibited by automatic writing within hypnosis. The subject is told to be unaware of what the hand and arm are doing. The task, often done at a signal post-hypnotically, may be to write a letter or complete arithmetic problems. Simultaneously, the subject is engaged in some conscious task such as reading a book aloud. Dissociation is evidenced by the total lack of awareness of the writing performance, and the subject's surprise at the performance (Knox, Crutchfield & Hilgard, 1975; Stevenson, 1976). Hilgard's (1973, 1974, 1977) discovery of the hidden observer represents the most recent and dramatic advance in dissociation research. The hidden observer is a way of describing the "cognitive apparatus that was recording experiences of which the subject was unaware at the time, in a form that could be later recovered." Dissociation is evidenced by a subject's automatic writing report of painful stimulation in the midst of verbal report and behavioural observation consistent with analgesia within hypnosis (Hilgard, Morgan & Macdonald, 1975; Hilgard, Hilgard, Macdonald, Morgan & Johnson, 1978; Hilgard, Macdonald, Morgan & Johnson, 1978; Crawford, Macdonald & Hilgard, 1979).

Investigations by Hilgard and his associates support the view that there is stability of hypnotic talent within subjects. Morgan, Johnson and Hilgard (1974) found no significant mean changes on the Stanford Scales over an average ten year period. The earlier scores correlated .60 with the later ones. Some individuals did change, however, and the neo-dissociation theory does not preclude the possibility of significant and meaningful enhancement of hypnosis.

The present investigator reasons that sensory restriction or sensory deprivation can serve to force the organism to develop a coping strategy to mitigate the stress created by lack of stimulation. The subject focuses, perhaps as seldom or never before, on the production of internally generated imaginal activity. It would seem that such a defensive manoeuvre could be conceptualized as a dissociative reaction.

Josephine Hilgard (1974) found strict childhood discipline to be positively related to high hypnotizability. The finding could not be accounted for by conformity behaviour because the conforming subjects were the ones who were less frequently punished. Instead, a relationship between punishment and fantasy development was supported which was felt to be "the bridge to hypnotic susceptibility". Of the higher punishment subjects, 57% reported fantasy either as an accompaniment of the punishment experience or as an after effect. These children developed fantasies not only to block the physical pain of the punishing experience, but also to combat boredom when sent to their rooms. Apparently, the child learned to mitigate the effectiveness of the punishment through imaginal involvement of practised dissociation (Hilgard, 1979a). As Hilgard

(1979a) noted "what the child did was to engage in satisfying fantasies". It seems to this author that the dissociative responses learned upon being sent to his or her room, or quite commonly to bed, would seem to include at least some elements of sensory restriction.

In contrast to Reyher's theory it seems that Hilgard's theory allows for learning. The child's dissociative reaction consists of learned imaginal involvement in response to punishment stress, possibly involving sensory restriction. Josephine Hilgard's "bridge to hypnotic susceptibility" suggests her findings may bear a causal rather than merely correlative relationship with later high hypnotizability. Can a sensorily restricted environment force adults to develop imaginal involvement with a resultant enhancement of hypnotizability?

Dissociative reactions seem apparent in the coping responses reported in anecdotal literature on Antarctic service. Gunderson (1973, p.150) noted "Personnel can work hard all day and then when they go to bed cannot sleep. I also catch myself and all others sitting down and staring at the bulkhead and not thinking about anything." Natani and Shurley (1974) noted the "long eye stare phenomenon", peculiar to the Antarctic "may bear a close relationship to the staring reaction found in individuals who have witnessed a large scale disaster."

E.R. Hilgard's theory combined with J.R. Hilgard's findings converge on a similar prediction to that of Reyher's theory. Specifically, exposure to sensory deprivation or restriction should result in an increase in hypnotizability. In contrast to Reyher's theory, however, Hilgard's approach seems to allow for learning. The Hilgard model would, therefore, predict maintenance of enhanced hypnotizability in later post-deprivation follow-up testing rather than Reyher's contrary prediction.

HYPOTHESES

On the bases reviewed above the following hypotheses were generated. An attempt has been made to advance alternative and conflicting hypotheses in those cases where the literature supports differential predictions.

General Hypnotizability Hypotheses

1) Hypnotizability will be significantly ($\alpha = .05$) enhanced for subjects exposed to the sensory/perceptual restriction of prolonged Antarctic isolation.

2) A. Hypnotizability will be significantly ($\alpha = .05$) enhanced for subjects exposed to laboratory controlled sensory deprivation immediately following the deprivation period. B. These subjects will also demonstrate significantly ($\alpha = .05$) higher hypnotizability scores as contrasted with control subjects.

3) A. In response to a post-hypnotic suggestion for glove analgesia subjects exposed to laboratory controlled sensory deprivation will demonstrate significantly ($\alpha = .05$) increased pain threshold and tolerance scores as contrasted with their pre-deprivation scores, immediately following deprivation. B. These subjects will also demonstrate significantly higher ($\alpha = .05$) pain threshold and tolerance scores as contrasted with control subjects.

Conflicting Hypnotizability Hypotheses

4) A. On the basis of Reyher's (1964) theory subjects exposed to laboratory controlled sensory deprivation will not differ significantly ($\alpha = .05$) in hypnotizability from their pre-

deprivation scores or from control subjects 10-14 days after deprivation.

<u>*VERSUS*</u>

5) B. On the basis of the present investigator's reasoning conceptualized within E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation theory and J.R. Hilgard's(1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation will demonstrate significantly ($\alpha = .05$) enhanced hypnotizability scores 10-14 days after deprivation as contrasted with their pre-deprivation scores and control subjects' follow-up scores.

6) A. On the basis of Reyher's (1964) theory subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia will not differ significantly in pain threshold and tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation.

<u>*VERSUS*</u>

7) B. On the basis of the present investigator's reasoning, conceptualized withing E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation theory and J.R. Hilgard's (1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia will demonstrate increased pain threshold and tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation.

<u>Conflicting Hypotheses Relating to EEG</u>

8) On the basis of Dumas' (1977) findings drafted subjects naive with respect to the focus of the research will not

demonstrate a significant ($\alpha = .05$) EEG alpha density correlation with hypnotizability either prior to or following the sensory/perceptual restriction of prolonged Antarctic isolation.

VERSUS

9) On the basis of Engstrom's (1976) findings drafted subjects naive with respect to the focus of the research will demonstrate a significant ($\alpha = .05$) EEG alpha density correlation with hypnotizability prior to and following the sensory/perceptual restriction of prolonged Antarctic isolation.

Hypothesis Relating to Skin Conductance Arousal

10) On the basis of Crosson's et al (1977) view it is hypothesized that Dumas' (1977) findings of no correlation between alpha density and hypnotizability for drafted naive subjects can be accounted for by suppression of subjects' typical eyes closed alpha due to arousal. Specifically, drafted subjects naive with respect to the focus of the experiment will demonstrate enhanced EEG alpha density and hypnotizability correlations prior to and following Antarctic isolation when portions of EEG records coincident with skin conductance measures of arousal are omitted from the computation of EEG alpha density.

Chapter II

REVIEW OF THE RELATED LITERATURE

Hypnotic Susceptibility

Hilgard (1965) concluded that while on logical grounds the measurement of hypnotic susceptibility would seem very precarious quite the opposite is true in actual practice. Subjects have been found to be as fully co-operative as they usually are on interest and personality tests which are subject to the same possibilities of falsification.

To test the short-term reliability of the Stanford Hypnotic Susceptibility Scale, Weitzenhoffer and Hilgard (1959) employed 124 subjects. Each subject was hypnotized on two occasions, separated by either one or two days. Using Forms A and B of the Scale, approximately half of the subjects were tested originally with the forms in the A-B order, and half in the B-A order. Weitzenhoffer and Hilgard (1959) noted that the two forms were "strictly comparable" and the gains between the two days were so slight that in using the test it is not necessary to make any general correction of scores to compensate for learning effect. The correlations between Day 1 and Day 2 can be interpreted as short-term test retest reliabilities. The combined results for all 124 subjects yielded a correlation of .83 between the two days. The even higher Kuder-Richardson reliability of .91 is obtained when Forms A and B were given to the same subject on different days.

In an examination of the distribution of susceptibility to hypnosis in a student population Hilgard, Weitzenhoffer, Landes and Moore (1961) analysed the responses of 64 males and 60 females to the Stanford Hypnotic Susceptibility Scale (Weitzenhöffer, & Hilgard, 1959). Hypnotic susceptibility was defined as "the number of responses representative of hypnosis yielded within the standard procedures of attempted induction and testing." It was further noted that as a sample of hypnotic phenomena the scale provides a *criterion* for personality studies; and as an *aptitude test* it predicts the capacity to go on to more varied and complex hypnotic experiences. Nineteenth century studies were reviewed. Using the categories developed in these earlier studies Hilgard, Weitzenhoffer, Landes and Moore (1961) found 17% of their subjects to be refractory to hypnosis, 35% drowsy-light, 25% moderate and 23% deep or somnambulistic. The distribution was very much in line with the earlier studies.

Morgan, Johnson and Hilgard (1974) investigated the stability of hypnotic susceptibility longitudinally. Eighty-five former

Stanford University students were retested on the Stanford Hypnotic Susceptibility Scale, Form A (Weitzenhoffer & Hilgard, 1959) after an 8-12 year retest interval. Results of the study showed no overall change in level of susceptibility and the correlation between the total scores on the two testings was .60. Additionally, there were no significant differences between men and women in the percentage passing each item in either session. It was concluded that hypnotic susceptibility seems to be relatively stable over long periods of time in spite of major life changes that inevitably occur between the ages of 20 and 30. Most subjects in the sample studied had finished university and begun a career during the 8-12 year testing interval. The majority had married and started a family. The hypnotic susceptibility score, for most subjects, did not change more than a point or two in spite of different experimenters and a different testing session. It is of interest to note, however, that 18 subjects changed more than 1 standard deviation (S.D. = 3.2 for retest) and 4 subjects showed an increase of 7 or more points on the 12 point scale. As reviewed in Chapter I both Reyher's (1964) and Hilgard's (1977) theories allow for modification of hypnotic susceptibility. Hilgard (1965, p.71) noted "without special intrusions, hypnotic susceptibility is reasonably stable; with intrusions of various kinds, ..., some dramatic changes may occur". Prior to reviewing studies putative to enhancing hypnotic susceptibility it seems regnant to summarise concerns bearing on potential methodological and procedural problems.

Evaluative Criteria for Modification Studies

Generalization - It would seem that studies purporting to modify hypnotizability should include the provision of generalization data beyond that of hypnotic susceptibility test scores as a criterion measure if statistically significant changes are to be considered meaningful. Clearly, there is a need for criteria outside of test scores to make the leap from statistical significance to psychological meaningfulness. As Perry (1977) pointed out, De Voge and Sachs (1973) showed highly significant ($p < .005$) increases on the Harvard Group Scale of Hypnotic Susceptibility (Shor & E.Orne, 1962) although the range of mean increases over four modification training groups was only from .50 to 2.55 scale points. Yet, the authors concluded that "although imitation may produce only small and undramatic increases in susceptibility, these increases appear to be significant and fairly consistent among Ss." No outside criterion measures were considered to evaluate the meaningfulness of these "significant" increases.

Follow-up - It would seem that studies purporting to modify hypnotizability should provide follow-up data for some reasonable period after experimental testing. Perry (1977) suggested that the issue of follow-up is intimately linked with that of generalization. He noted that if it is a "skill or trait that is being modified in such studies, it is important methodologically to demonstrate that subjects are not simply being taught to be test-wise to the training instrument employed". Few modification studies have considered follow-up data. The little evidence available is conflicting. Kinney and Sachs (1974) found no decrease in enhanced hypnotizability in a one month follow-up, but Sachs and Anderson (1967) found a significant reduction using an independent experimenter. Diamond (1972) found no decrease at follow-up, but the period was only 2-7 days. Gur (1974) completed a follow-up but the period was not specified. Apparently, no study has ever employed a criterion measure outside of hypnotizability test scores at follow-up.

Plateau Hypnotizability - It would seem that studies purporting to modify hypnotizability should consider plateau hypnotizability. Shor, Orne and O'Connell (1962) introduced the concept of plateau hypnotizability or plateau susceptibility. They reported that most subjects reach a plateau of hypnotic performance after a variable number of hypnotic sessions. Fear of being controlled by the hypnotist or fear of having an unpleasant experience may inhibit many subjects until they have been hypnotized at least once. Little research has focused on plateau phenomena. Shor, Orne and O'Connell (1962) found a significant correlation of .83 ($p < .001$) between an initial testing and a plateau score on the Stanford Hypnotic Susceptibility Scale Form A. Examination of the subjects' scatter plots, however, revealed that over a third of them scored "appreciably" higher on the initial testing than on the plateau score. Further support for the importance of considering plateau susceptibility was found in an investigation of psychological correlates of plateau hypnotizability in a volunteer sample of 25 university students interested in hypnotic experimentation (Shor, Orne & O'Connell, 1966). Several hypotheses about correlates of hypnotizability were tested. Defining hypnotizability as a plateau performance rather than as some briefer estimate was shown to be cogent. Only one susceptibility modification study attempted to bring subjects to plateau prior to an attempt at modification (Shor & Cobb, 1968).[1] The sample consisted of only 8 subjects. There was no significant increase from training to plateau, suggesting (Sachs, 1971) that plateau susceptibility may be of negligible importance. Perry (1977), however, noted that while there were both significant increases from initial to final score, and from plateau to final, the increase was much greater for the former comparison. It would seem that while plateau susceptibility might not be important enough of a factor to necessitate repeated hypnotic inductions, thus creating another situational variable, prior to an attempt at modification it does warrant consideration in some manner. Repeated inductions for control subjects would seem to serve the purpose of revealing plateau effects in any specific modification study.

<u>Situational factors</u> - Hilgard (1965, p.69) noted, "thus the capacity of the subject to resist hypnosis on the part of a

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[1]NOTE: Shor and Cobb (1968) presented only raw data so t values were computed by the present author and, apparently, by Sachs (1971) and Perry (1977).

hypnotizable person is recognized; if this is the case, subjects may presumably show varying degrees of resistance, depending upon circumstances, and underestimates of potential hypnotizability may therefore result from testing under unfavourable circumstances." In a study of the effect of the experimenter's tone of voice on Barber Susceptibility Scale (Barber, 1965) scores, Barber and Calverley (1964a) found a "forceful" tone led to higher scores as contrasted with a "lackadaisical" tone. In another investigation scores on the Barber Scale were higher for a "positive attitude-motivational" instructions group contrasted with groups receiving "neutral" or "negative" instructions (Barber & Calverley, 1964b). "Favourable information" about hypnosis, given prior to testing has also been shown to yield higher Barber Scale scores (Cronin, Spanos & Barber, 1971). Other situational variables may also be relevant. As discussed in Chapter 1, Dumas (1977) found the only consistent covariate of studies demonstrating significant EEG alpha-hypnotizability correlations to be the method by which subjects were selected.

Demand characteristics - Orne (1959) found that cues implicit in the experimental design and/or procedure could communicate the experimenter's hypothesis and lead the subject to provide data confirming the predictions of the investigator. Orne (1959) noted that a "subject participating in an experiment is aware his responses are being recorded for specific purposes - that there is a *raison d'etre* for the experiment - and he frequently has some idea what these purposes are." University students typically volunteer out of interest or desire to further "progress in science". Since the experimenter is viewed as one who can further "progress in science" this may be equated by the subject as "making the experiment work." Thus, as Orne (1959) points out, the subject is motivated to comply with the wishes of the experimenter and responses to the experimental intervention are influenced by what is perceived to be the hypothesis of the experiment. Orne (1959) described a post-experimental inquiry technique and concluded that "If an S can describe a hypothesis being tested, of which he is supposedly unaware, the experimental arrangements have significant demand characteristics."

Perry (1977) suggested that there may be no other way of performing hypnotic susceptibility modification studies without telling subjects that increased performance is what the experimenter hopes to obtain. Indeed, this is what most investigators have done. Sachs and Anderson (1967) provided subjects "with a clear conception of the sensory experiences associated with a successful performance". Sanders and Reyher (1969) told subjects "that the session was designed to test the effect of sensory deprivation on her ability to be hypnotized." Tart (1970) "explained the purpose of this study." Diamond (1972) employed subjects who volunteered for a study of "increasing hypnotic susceptibility". Kinney and Sachs (1974) told subjects, "the purpose of this experiment is to help you learn to become hypnotized...Anyone can learn to be hypnotized"! (exclamation mark added). Despite the wide use of such instructions and other clues in the design no hypnotic susceptibility modification study has ever employed Orne's (1959) post-experimental inquiry technique in an effort to determine the influence of demand characteristics.

Modification of Hypnotizability

Modalities other than sensory deprivation - While it would not be appropriate to the focus of the present thesis to review, in detail, modification studies outside of those related to sensory deprivation, it may be helpful to briefly recognize the range of investigations employing other modification modalities.

Psychedelic drugs have been employed in efforts to enhance hypnotic susceptibility. Fogel and Hoffer (1962), Levine and Ludwig (1965), Solurish and Rae (1966) and Ulett, Akpinar and Itil (1972) all concluded that hypnotic experiences were enhanced by the administration of LSD-25. Sjoberg and Hollister (1965) found primary suggestibility enhancement by using LSD-25, mescaline and combinations of both with psilocybin. Middlefell (1967) found LSD-25 to enhance hypnotic responsiveness for neurotic patients but not for schizophrenics or depressives. Beahrs, Carlin and Shehorn (1974) used cannabis and/or haloperidol but found no systematic effect on hypnotizability. Kelly, Fisher and Kelly (1978) found an increase in suggestibility using cannabis but the effect failed to persist when subjects were retested a week later.

Increasing the subject's desire to be hypnotized has been reported to increase susceptibility (Heron, 1953; Kroger, 1963; Pattie, 1956; Sarbin, 1950; Secter, 1957; Wolberg, 1948), while hyperventilation has been reported to "facilitate" susceptibility (Baykushev, 1969; Sargent & Fraser, 1938; Stokvis, 1955).

Task-motivational instructions including exhortations to respond and demands for compliance have, not surprisingly, shown increases in hypnotizability over "baseline standard" instructions or "imagination-only" instructions (Barber, 1969; Barber & Calverley, 1962, 1963a, 1963b; Bowers, 1967; Diamond, Steadman, Harada & Rosenthal, 1975; Gregory & Diamond, 1973; Schaefler & London, 1969; Slotnick, Liebert & Hilgard, 1965; Slotnick & London, 1965).

Providing observational information, in the form of video taped models, has been reported to increase hypnotic susceptibility (Diamond, 1971; Diamond, 1972; Engstrom, 1973). Devoge (1971) and Devoge and Sachs (1973) attempted to modify hypnotic susceptibility through imitative behaviour. Significant enhancement effects were reported but direct reinforcement in the testing sessions made the results difficult to interpret. In a study using hypnosis modelling and information, Havens (1977) concluded that "facilitative information presented in a programmed-learning-text format may be a useful technique for enhancing hypnotizability." It was further noted that "it is desirable that members of the general population not be exposed to hypnotic subjects being punished or ridiculed and that non-facilitative statements should be avoided."

Biofeedback techniques have been employed to enhance susceptibility. Wickramasekera (1973) reported success with electromyographic (EMG) feedback using a selected subject sample. Electroencephalographic (EEG) alpha feedback has also been used (Engstrom, London & Hart, 1970; London, Cooper & Engstrom, 1974; Moore, 1975).

A wide variety of additional procedures have been used in attempts to increase hypnotic susceptibility. Wilson (1967) told subjects to imagine various effects while using hidden lights to help them actually experience the effects. Kroger and Schneider (1959) used a "brain-wave synchronizer" to produce photic driving of alpha EEG. Tart (1970) found Esalen Institute involvement in "directed imagery, sensory awareness and encounter groups" to enhance hypnotizability. Shapiro and Diamond (1972) found "interpersonally oriented encounter group training" to increase hypnotizability. Katz (1976) employed combinations of sleep/trance instructions and behaviour modification. Leva (1974a) used audio-taped relaxation training while Springer, Sachs and Morrow (1977) used relaxation training and specific task training procedures. In a review article Diamond (1974) cited a number of modification attempts including uncontrolled clinical and anecdotal reports dating back to Esdaile's use of "non-verbal mesmeric passes" to facilitate susceptibility in the year 1846.

In each of the studies cited in the section above the investigators failed to consider three or more of the evaluative criteria discussed previously.

A number of studies directed to the modification of hypnotizability have emanated from E.R. Hilgard's Laboratory of Hypnosis Research at Stanford University. In general, these studies have been better controlled than those cited in the section above, all of them were, however, limited to changes measured on standardised tests of hypnotic susceptibility and procedural demand characteristics may have influenced the results.

As, Hilgard and Weitzenhoffer (1963) used repeated individualized hypnotic experience (4-10 sessions) to increase hypnotizability in a sample of 10 female university students. Cooper, Banford, Schubot and Tart (1967) attempted to test Blum's (1963) implication that greater success at modification could be obtained with subjects initially in the low range of susceptibility. Essentially, Cooper et al (1967) replicated the earlier As, Hilgard and Weitzenhoffer (1963) study using 7-16 individualized "hypnotic sessions" from 1 to 2 hours duration each. Sachs and Anderson (1967) employed 10 students as subjects and 1) provided "circumstances necessary for a clear conception of the appropriate sensory experiences", 2) allowed subjects to proceed by "self-paced successive approximations," 3) "structured the procedure to place S in a double-bind situation", and 4) provided "verbal reinforcement and opportunities for S's self-reinforcement." Diamond (1972) exposed initially low susceptible students to a video taped model who acquiesced to seven hypnotic suggestions. Verbal "modelling cues" including information designed to correct misconceptions concerning hypnosis and "concrete methods for experiencing hypnosis" were also presented. Kinney and Sachs (1974) told their student subjects that "anyone can learn to be hypnotized" and used seven operant training sessions on successive school days. The sessions included practice in "relearning the ability to reintegrate certain types of sensations," provision of information regarding ways of "remembering certain sensations," specific training on test items allowing subjects to begin at their "own operant level for each item," and verbal encouragements for every initial step of progress" followed by a decrease in verbal reinforcement as the subject developed "self-reinforcement derived from his own gratification on complete success (e.g. his spontaneous excitement after not being able to lift the 'heavy' arm)."

Hilgard (1979) cited the Stanford Lab studies above and noted, "the results, in agreement with those found by others, are generally that small changes can be produced, statistically significant if samples are large enough, but there is no convincing evidence for the production of truly highly responsive subjects from those who who are originally only moderately responsive."

Enhancement of Hypnotizability by Sensory Deprivation/Restriction

Since the major focus of the present thesis relates to the study of the effects of sensory deprivation/restriction on hypnotizability it seems appropriate to review the relevant investigations in detail and to briefly cite previous research which formed a basis for these investigations.

Independent of the hypnosis literature, susceptibility to external influence following sensory deprivation/restriction was first studied in connection with investigations of brainwashing. Hebb (1961, p.6) noted "the work that we have done at McGill University began, actually, with the problem of brainwashing...The chief impetus, of course, was dismay at the kind of confessions being produced at the Russian Communist trials." Although the McGill studies and their successors did not focus directly on hypnotizability they functioned as a prelude to work on hypnotic susceptibility so they are worth mentioning. The results, encompassing changes in primary suggestibility (Hilgard, 1965) are mixed.

Vernon and Hoffman (1956) exposed four subjects to 48 hours of sensory deprivation. They concluded that "Attempts to measure the effect of sensory deprivation on suggestion, by the Hull body-sway techniques, proved unsuccessful." Body-sway or postural sway has been used as a standard hypnotic susceptibility item for a long time (Berreman & Hilgard, 1936; Eysenck &

Furneaux, 1945; Hilgard, 1965; Hull, 1933). Later Vernon (1961, 1963) found that sensory deprivation significantly increases body-sway suggestibility. Jones and Goodson (1959) seated 24 naval aviation cadets individually in a 2 feet by 3 feet booth with blank walls and a humming air conditioner. The deprivation period was 8 hours and experimental subjects were significantly more suggestible than controls on body-sway measures. There was a tendency toward significant effects for arm levitation and leg catalepsy. Walters, Callagan, and Newman (1963) failed to confirm these findings using only social isolation without sensory deprivation or sensory restriction. Walters and Quinn (1960) exposed their subjects to 30 minutes of either sensory deprivation, social isolation, both or neither. The deprivation plus social isolation group showed the lowest latency and highest suggestibility on the autokinetic effect. Sleep deprivation, which in the present investigator's view included elements of sensory restriction, also increased autokinetic suggestibility (Fisher & Rubenstein, 1956). Social isolation only, showed no such effects (Walters, Marshall & Shooter, 1960).

Zubek (1969) reviewed the extensive literature on the reports of visual imagery during sensory deprivation/restriction. It was noted that "...we can say at the very least that in numerous experiments SD (sensory deprivation) phenomena have been attributed not to SD itself, but to suggestion and/or expectation. The role of *increased* suggestibility as a result of SD has not been investigated specifically in this context, but it should be."

Other experiments have shown that social isolation and sensory restriction procedures enhance the acquisition of simple psychomotor tasks, verbal conditioning, and susceptibility to social influence, propoganda, and psychotherapy (Bexton, Heron & Scott, 1954; Cooper, Adams & Gibby, 1962; Gewirtz & Baer, 1958a, 1958b; Gibby, Adams & Carrera, 1960; Heron, 1961; Paivio, 1963; Stevenson & Odom, 1962; Suedfeld, 1964; Walters & Karal, 1960; Walters & Ray, 1960). On the basis of a psychoanalytic model Gill and Brenman (1959, p.125) reviewed the seclusion of monks and the reduction of stimulation faced by others such as Arctic explorers. Gill and Brenman (1959) predicted an enhancement of hypnotic susceptibility by sensory deprivation procedures. The studies cited above gave rise to the first experimental investigations of the effects of sensory deprivation/restriction procedures specifically aimed at the enhancement of hypnotic susceptibility.

Levitt, Brady, Ottinger and Hinesley (1962) attempted to test the Gill and Brenman (1959) prediction using three female student nurses who had overcome a challenge of eyelid catalepsy following exposure to a ten minute audio taped hypnotic induction procedure. The induction included progressive relaxation, suggestions of drowsiness and hypnotic "sleep". Subjects were subjected to sensory restriction in a group. Subjects were seated in comfortable chairs in a "completely darkened, sound-resistant room." Thirty decibels of white noise was provided to each subject using padded earphones. Subjects wore cotton gloves covered with gauze wrapping and were restrained in stiff cardboard cuffs from above the elbows to below the fingers. Subjects were instructed not to sleep or to make any sounds. They were required to remain in the experimental situation for 4 hours and were paid $3 per hour for participation. At the end of the period the white noise was shut off and the "identical tape recording that failed to hypnotize them previously" was played to them over the earphones, concluding with the eyelid catalepsy challenge upon entering the room just before turning the lights on. All three subjects immediately opened their eyes without difficulty when the lights were turned on.

The negative results of the Levitt, Brady, Ottinger and Hinesley (1962) study are difficult to interpret because several factors which may have influenced the findings were not considered. Only the eye-catalepsy test was employed in a simple pre- versus post- measure despite the availability of a comprehensive standardized measure at the time (e.g. Stanford Scales, Weitzenhoffer & Hilgard, 1959). Failure on the eye-catalepsy challenge at post-deprivation testing cannot be interpreted as generalizable to possible alterations in subjects overall hypnotizability. The choice of the eye-catalepsy test as the single measure might also have been a particularly poor choice considering findings on the use of the related eye closure measure. Hilgard (1965, p.101) noted, "It is of interest that 10 per cent of those who did not close their eyes through suggestion still ended up in the upper half of the distribution of susceptibility. It is evident that eye closure as a single indicator of susceptibility is not enough." Stress related situational variables, in particular, may also have mitigated against post deprivation eye-catalepsy performance. Subjects seemed completely unaware of what awaited them while restrained in the dark room, possibly creating hostility toward the investigators. Subject number 1 was "fighting against the cuffs" and reported feeling "terrified" and "more frightened when the taped hypnotic instructions began". Both subject number 2 and number 3 reported the expectation that they might be given an electric shock as part of the experiment. Subject number 2 thought that "an experimental procedure involving the induction of anxiety or withdrawing of blood might be introduced at any time." Richie (1976) found a decrease in susceptibility for subjects exposed to stress.

In summary it seems that while the Levitt, Brady, Ottinger and Hinesley (1962) study was a pioneering effort it failed to contribute to our understanding for the following reasons: The hypnotizability measure was inadequate, situational variables may have negatively influenced post-deprivation catalepsy performance, no attempt was made to obtain generalization data beyond the single test item, plateau susceptibility was not considered, there was no control group nor was there any attempt at follow-up testing. Finally, it is difficult to generalize from a study in which the number of investigators exceeds the number of subjects studied.

Pena (1963), apparently unaware of the work of Levitt, Brady, Ottinger and Hinesley (1962), investigated the effects of "perceptual isolation" on hypnotic susceptibility using 45 male prisoner volunteers as subjects. Subjects were divided into one control (no treatment group) and two experimental groups. All subjects were tested with Form A of the Stanford Hypnotic Susceptibility Scale during their first interview. After a 24 hour interval, which included experimental exposure for two of the three groups, all subjects were retested on Form B of the Stanford Hypnotic Susceptibility Scale. Enhancement of hypnotizability was defined as the difference between the test and retest scores. The two experimental groups were exposed to either 1½ or 3 hours of sensory/perceptual isolation immediately followed by the hypnotic retest session. "Isolation" subjects were seated in a chair using pillows to maximise comfort. White noise was provided using padded earphones. Subjects wore earplugs, cotton gloves and halved ping-pong ball goggles. Silence and immobility were requested. Pena (1963, pp. 28-29) apparently went to considerable effort to assure maximal auditory blocking. Using non-parametric statistical tests all groups, including the control group, showed significant gains in hypnotizability. Enhancement scores showed the greatest increase for the 3 hour deprivation group and lowest gains for the control group. It was concluded that the statistically significant enhancement of hypnotizability was "associated with three hours perceptual isolation and, in part, with practice effects and implied suggestions and cues incorporated in the procedures."

Contrary to the findings of Levitt, Brady, Ottinger and Hinesley (1962) post experiment interviews conducted by the investigator revealed that both deprivation groups reported predominantly pleasant thought content although some stress was noted. "Heightened vividness in thoughts and images was common to both (deprivation groups)."

In summary, it appears that while the doctoral dissertation research of Pena (1963) was better controlled than the Levitt, Brady, Ottinger and Hinesley (1962) investigation the study suffered from major problems. Aside from the unique sample consisting of unsuccessful criminals it appears that demand characteristics, possibly interacting with situational variables, could account for the apparently successful enhancement of hypnotizability. Pena (1963) told his volunteer subjects that the project was "important" (p.26) and "involved hypnosis" (p.27). It was admitted that the experiment "may have entailed implied suggestions, or cues which affected expectancies and motivation." (p.55) and that "it is quite plausible that the hypothesis may be (have been) implicitly conveyed by the experimental procedures." Indeed, the 3 hour deprivation group had the greatest investment in the project and thereby produced the greatest enhancement of scores. Although a standardized multi-item test of hypnotizability was a clear improvement over the eye-catalepsy test of Levitt, Brady, Ottinger and Hinesley (1962) there was no attempt at follow-up testing nor was any attempt made to obtain generalization data beyond that of the standardized test. Plateau susceptibility changes may have been reflected in the significant gains shown by the control subjects.

Shor and Cobb (1968) investigated hypnotic training using plateau responsiveness as a referrent. This carefully conducted study involved great attention to detail and was conducted over a number of summer seasons using an individualized case study method. The study was mainly concerned with plateau responsiveness (Shor, Orne & O'Connell, 1966). Shor and Cobb (1968) noted:

> "More than half of each summer was needed just to bring them to plateau. Very little time remained to try to maximize hypnotizability beyond plateau. The essential concern was to record the process of training, to explore the effectiveness of new techniques, and to ascertain whether the basic definitions and procedures led to a workable methodology. Unexpectedly , despite the small amount of time available for training after plateau, five out of the eight subjects did improve in responsiveness..." (beyond plateau).

The Shor and Cobb (1968) study did not focus specifically on the experimental enhancement of hypnotizability by sensory deprivation/ restriction. It is mentioned in the present review because it is the only modification study extant that demonstrates extensive control of plateau susceptibility and because the measure of hypnotizability increased after plateau. It is of particular relevance to the present thesis because "The most encouraging happenings in the study occurred while administering suggestions in the extended sensory-isolation type settings." The production of enhanced hypnotic responses during sensory-isolation seems consistent with Reyher's (1964) theory (see Chapter I present thesis). Consistent with Josephine Hilgard's (1974) findings (see Chapter I present thesis) Shor and Cobb's (1968) sensory-isolation sessions served to create:

> "...formation of extremely vivid dreamlike experiences which directly and immediately developed from the hypnotic suggestions of fantasized scenes being presented at the time. The subjects were unclear as to whether they were awake and they were so impressed with the striking reality of the induced dreams that they needed independent confirmation from the experimenter on whether the experiences occurred in dreams or in reality."

Wickramasekera (1969) conceptualized his study of the effects of sensory restriction on susceptibility to hypnosis within Gill and Brenman's (1959) psychoanalytic model and within a social-learning motivational model. As in Pena's (1963) study, the Stanford Scales were used as the sole measure of hypnotizability. Form A was administered before sensory restriction and Form B was administered immediately after sensory restriction. Subjects consisted of 16 female college freshmen who were paid $2.50 each for participation. Subjects were told "we are doing research on hypnosis". Subjects were randomly divided into control and experimental groups with 8 in each group. Each administration of the Stanford Scale took about 55 minutes. Experimental subjects were exposed to sensory restriction for 30 minutes. Subjects wore "goggles with lenses painted over with three heavy coats of black paint" and a "masking tone" was provided through headphones. Subjects also wore cotton gloves and were told to remain as motionless as possible. No explanations or suggestions regarding the expected effects were given to subjects or the research assistant who timed and scored the Stanford Scale. Wickramasekera (1969) completed all administrations of the hypnotizability scale. Non-parametric statistical tests on the Stanford Scale scores showed a significant increase in hypnotizability for the experimental subjects and a significant difference between the post-test scores of the experimental and control groups.

In summary it appears that Wickramasekera (1969) completed a pilot study which, like that of Pena (1963), hints at possible sensory deprivation effects on hypnotizability. The significant findings of the Wickramasekera (1969) investigation must be viewed with caution because of the probable influence of demand characteristics and situational variables in particular. The author raised the "possibility of E bias in the administration of the Stanford Hypnotic Susceptibility Scale" and the possible increase in "the general interpersonal influence of E" particularly for the sensory deprivation subjects. Post experimental interviews apparently were not structured to explore these problems. No follow-up testing was completed nor was there any attempt to determine generalization of the increases in measured hypnotizability. Plateau susceptibility did not appear to be a significant influence as control (no treatment) subjects failed to show significant gains in hypnotizability scores.

Following the pilot investigation (Wickramasekera, 1969), Wickramasekera (1970) completed a more elaborate study of sensory restriction and susceptibility to hypnosis. Subjects consisted of 45 volunteer young male prisoners screened for age, IQ, and academic achievement. Subjects were randomly assigned to three groups of equal size. Experimental subjects (groups 2 and 3) were exposed to 1 hour of sensory restriction. Sensory restriction conditions were similar to those described above (Wickramasekera, 1969) except the period was expanded from 30 minutes to one hour. All subjects were told that this was an "important psychological experiment" and that the study "involved the induction of hypnosis". Immediately prior to exposure to sensory restriction subjects in groups 2 and 3 were told, "today you will do nothing for an hour before you are tested again for hypnotic susceptibility." Group 3 also received additional anxiety arousal instructions about the possibility of feeling "stir crazy" during sensory restriction or that they "may even hear or see and feel unusual things during this period." Following termination of sensory restriction subjects were again reminded of the focus of the study, "please follow me now to the office next door so that we may begin the retesting of your hypnotic susceptibility." Control subjects (Group 1) were not exposed to sensory restriction but sat in the same room used for the experimental subjects for one hour with access to magazines and a radio. All subjects were tested before and after the above procedures with Form A and B of the Stanford Hypnotic Susceptibility Scale. Both experimental groups demonstrated a significant increase in hypnotizability on post testing. The control group showed no significant increase.

In summary, it appears that while Wickramasekera's (1970) investigation involved a greater number of subjects and a longer deprivation period than the earlier pilot investigation it still did not consider the clear demand characteristics of the instructions. No attempt was made to collect follow-up data or to provide generalization data beyond that of the standardized test of hypnotizability.

As Leva (1974b) noted, the most successful hypnotizability enhancement study was completed by Sanders and Reyher (1969). Sanders and Reyher (1969) attempted to test Reyher's (1964) psychophysiological theory of brain function and behavioural regulation by investigating the effects of sensory deprivation on hypnotic susceptibility. Experimental subjects consisted of 10 college-age females who scored below 4 points on Form A of the Stanford Hypnotic Susceptibility Scale (12 points max possible score). Subjects were subjected to a maximum of six hours of sensory deprivation or until signs of deprivation were elicited such as craving for stimulation, emotional lability, or impaired secondary process (mean time in deprivation = 4.5 hours). Subjects reclined on a bed in a light and sound attenuated cubicle. Subjects wore a headset consisting of a microphone and earphones, which was part of an integrated communication system which also included a voice-activated tape recorder and an amplifier. Subjects' galvanic skin response (GSR) was recorded continuously. Subjects were able to obtain three stock market quotes by pressing a button which activated a light in the adjacent room. Each subject was "told that the session was designed to test the effect of sensory deprivation on her ability to be hypnotized" and to tell the investigators about her experiences while in sensory deprivation. The latter information was used to make the "clinical judgement" to terminate deprivation for certain subjects in less than the allotted 6 hours. Upon termination of deprivation the hypnotic induction for the Form B administration of the Stanford Scale was then undertaken via the communication system, while the subject remained in the deprivation cubicle. Approximately 1 week following the experimental session, subjects submitted once again to Form A of the Stanford Scale. A control group consisting of 10 subjects, similar to the experimental subjects, was also included in an effort to assess demand characteristics and, presumably, plateau susceptibility effects. Pre-testing on Form A of the Stanford Scale was completed in the same fashion as for the experimental subjects. Post-testing on Form B was completed after 4.5 hours of non-deprivation control conditions. Control subjects "also returned for a final session to assess their final level of susceptibility" using Form A of the Stanford Scale. Apparently, this final session was meant to correspond to the 1 week follow-up used with the experimental subjects. Curiously, this follow-up period was not specified by Sanders and Reyher (1969) or Sanders (1967, p.14) but only referred to as a "final" session. Only the experimental group demonstrated a significant and dramatic increase in hypnotic susceptibility and this was maintained in the follow-up testing. Emotionality, as measured by GSR, did not correlate with enhancement of hypnotizability.

In summary, it appears that the Sanders and Reyher (1969) investigation is of particular interest because of the magnitude of the changes in enhancement of hypnotic susceptibility combined with the lack of significant change for the control group. The attempt to obtain useful psychophysiological data during deprivation was laudable but the measure chosen (GSR) was inadequate (Barabasz, 1977a, p.130-32). The findings were viewed as consistent with Reyher's (1964) (see Chapter I, Theoretical Perspectives) theoretical model but the enhancement increases, still present at follow-up testing, could not be accounted for by the theory. Unfortunately, the demand characteristics of the specific instructions combined with hypnosis related situational variables (e.g. presence of the autokinetic light in the deprivation cubicle) could have accounted for the follow-up finding and/or the post-test finding. The provision of a generalization measure beyond that of standardized hypnotic susceptibility test scores would also have strengthened the study considerably. As noted in Chapter 1, Reyher's (1964) theory remains to be tested

Leva (1974b) criticized Sanders and Reyher's (1969) use of the Stanford Hypnotic Susceptibility Scale (Form A and B) because of its heavy loading of primary suggestibility (Hilgard, 1965) ideomotor items (i.e. arm immobilization). Leva (1974) contrasted the Stanford Hypnotic Susceptibility Scale (Forms A and B) with the Stanford Profile Scales (Weitzenhoffer & Hilgard, 1967) which are characterized by a lack of motoric items. The Profile Scales contain such items as age regression and hallucinations which are cognitive in nature. It was noted that these items are "more difficult to experience, and for the most part only experienced by highly susceptible Ss". Leva (1974b) initially screened a "large group" of university students with the Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1962). From a pool of low scoring subjects 10 males were randomly assigned to either a control (no treatment) group (N = 5) or sensory deprivation group (N = 5). All subjects were then pre-tested on the Stanford Hypnotic Susceptibility Scale Form A and the Stanford Profile Scale Form I. Subjects in the deprivation group were exposed to essentially the same procedure as employed by Sanders and Reyher (1969) except cotton gloves were added and "darkened goggles" substituted for the light attenuated room. This latter modification made it possible to observe subjects and, presumably, was employed as an aid in applying the clinical criteria and to insure subject safety. The Stanford Scale Form B and the Profile Scale Form II were administered immediately after deprivation for experimental subjects and immediately after a 1 hour waiting period for control subjects. Results, as predicted, showed a significant increase for deprivation subjects on the Stanford Hypnotic Suscpetibility Scale using a "simple test" for main effects. Analysis of variance was performed on the Profile Scale scores and, as predicted, the average 2 point increase was not significant. Control subjects' scores remained the same on the Profile Scales and showed no significant change on the Stanford Hypnotic Susceptibility Scale. Efforts to identify the "simple test" or the rationale for employing different statistical tests for the two scales were unsuccessful.[1]

In summary, Leva (1974b) essentially replicated the work of Sanders and Reyher (1969) but used only 5 subjects in each of 2 groups. Leva's criticism of Sanders and Reyher's use of the Stanford Hypnotic Susceptibility Scale may have been ill-founded because examination of Sanders' (1967) data shows that two of the three non-motoric items changed as much as the motoric ones for the deprivation subjects. Insufficient detail was given in the Leva

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1 Leva's (1971, unpub.) dissertation text was unavailable and two letters of enquiry received no reply.

(1974b) report for a thorough evaluation, but it would seem from the information available that demand characteristics and/or situational variables could have accounted for the results supporting his prediction. Despite Diamond's (1970) finding that sex is not generally a significant factor sex differences between the studies may also have played a part in the findings; Leva (1971, 1974b) used males while Sanders and Reyher (1969) used females as subjects. Leva's (1974b) use of an analysis of variance to evaluate the Profile Scale results seems especially puzzling considering that the scores may not meet parametric assumptions, and the N of only 5 mitigates against significance. The question as to why a different and unspecified statistical test was used for the Stanford Hypnotic Susceptibility Scale results must also be raised. The findings remain difficult to interpret. No follow-up data was collected and no attempt was made to provide generalization data beyond that of the hypnotizability measure.

King and Lummis (1974) studied the effects of visual sensory-restriction and recent experience with the imagined stimulus on a single suggestibility item. On the basis of correlational studies it was hypothesized that visual sensory-restriction should increase imagery. King and Lummis (1974) also reasoned that recent exposure to the stimulus to be imagined should increase responsiveness. Subjects consisted of 80 black female university students. Visual sensory restriction consisted of placing white, translucent patches over both eyes. White light was admitted, but perception of detail or differences in light intensity was not possible. The effect was described as a homogeneous white field. The subjects who were requested to imagine that an extended arm was heavy and falling while exposed to visual-restriction exhibited a greater arm-drop than subjects given the same request and permitted normal vision. A second condition employed to promote imagery involved recent experience. A string was attached to the subject's wrist with a weight on the other end. The recent experience condition failed to increase arm-drop.

While the King and Lummis (1974) study only involved a single simple motoric item tested during visual-sensory-restriction the study is probably one of the least influenced by demand characteristics. It might be argued that subjects interpreted the homogeneous visual field as a cue or demand for behaving more extremely (i.e. exhibiting greater arm drop) but in the light of the failure of the recent experience group to show significant change such an argument is difficult to substantiate. The experimental task was simple, involved identical instructions for all subjects and involved little investment (in terms of situational variables) for the visual sensory restriction group. The failure to complete a post-experimental inquiry to determine demand characteristics is unfortunate. Nonetheless, this relatively simple study may have been better controlled in terms of demand characteristics than those previously discussed and it seems that sensory restriction served to enhance suggestibility performance. The present investigator was also impressed by the study as its focus on increased imagery during sensory restriction can be interpreted as consistent with Hilgard's (1977) neo-dissociation theory of hypnosis discussed in Chapter I.

Talone, Diamond and Steadman (1975) examined the extent to which hypnotizability could be enhanced by two types of very brief sensory experiences involving visual sensory restriction. Subjects consisted of male and female university students in the low and moderate range (0-8) on a pre-test Harvard Group Scale of Hypnotic Susceptibility, Form A (Shor & Orne, 1962). Subjects were divided into 3 groups of 13 each, consisting of two experimental groups and one no-treatment control. No attempt was made to equate the population of males and females in each group. One group was exposed to 10 minutes of auditory stimulation in the form of recorded music which was "chosen based on its ability to facilitate relaxation and imagery among pilot Ss." Subjects in the "silence group" were asked to close their eyes and remain silent for 10 minutes. Subjects in the no-treatment control group were exposed only to the hypnotic test scale. Post-testing consisted of Ruch and Morgan's (1971) version of the Stanford Hypnotic Susceptibility Scale Form C (Weitzenhoffer & Hilgard, 1962) adapted for audio tape-recorded administration (admin. time approx. 1 hr.). All Ss were also given self-report "Subjective C" questionnaires (Kinney, 1969). Using the Harvard Group Scale pre-test scores as the covariate, analysis of co-variance (one-way, fixed effects model) was computed on the Stanford Scale Form C scores. Results revealed "a strong trend toward significant treatment effects". Comparisons, using t-tests, demonstrated a significant difference between silence and control conditions but no significant difference between music and control conditions on the "Subjective C" scores.

In summary, the findings of the Talone, Diamond and Steadman (1975) study are not strongly supportive of successful modification of hypnotizability and may have been influenced by demand characteristics and situational variables. It would seem that even the most naive university student might accurately identify the hypnotic focus of a study in which the 10 minute treatment was immediately followed by a test of hypnotizability lasting over 1 hour. Indeed, the authors noted that "It is unclear from the present design whether actual susceptibility has been modified or whether what has occurred is rather that music/silence has sufficiently motivated S to try to be hypnotized." No follow-up testing was completed nor was there any attempt to obtain generalization data beyond that of hypnotizability scores or "Subjective C" questionnaire scores.

Richie (1976) explored primary and "advanced" susceptibility to hypnosis in a study of the effects of sensory deprivation and stress. Pursuing Leva's (1974b) findings (reviewed p.44) Richie (1976) used the Stanford Hypnotic Susceptibility Scales (Form A & B) and the Stanford Profile Scales (Form I & II). The experiment was conducted in three phases. Phase I consisted of pre-testing on the Stanford Form A and the Profile Scale Form I. Phase II consisted of sensory deprivation or stress treatments immediately followed by administration of the Stanford Form B and the Profile Scale Form II. Phase III was a 3 week follow-up administration of the Stanford Form A and the Profile Form I. Contrary to Leva (1974b) both primary and "advanced" susceptibility significantly increased following sensory deprivation. The increase on the Stanford Hypnotic Susceptibility Scale, tapping primary motoric susceptibility, was maintained at the 21 day follow-up testing session. Increases on the Stanford Profile Scales, tapping "advanced susceptibility" such as age-regression, were not maintained at the follow-up testing session. The primary and advanced susceptibility decreased for the stress group, and this decrease was maintained for both measures at follow-up testing. The control group showed neither an increase nor a decrease.

In summary, the Richie (1976) study demonstrated additional support for the use of sensory deprivation to enhance hypnotizability. In contrast to Leva's (1974b) conclusion, the results support the possible utility of the sensory deprivation procedure with more difficult to experience hypnotic phenomena. The differing results for the stress group may imply potential clinical applications for stimulus reduction (Suedfeld, 1980, p. 64). Unfortunately, as in the earlier studies Richie's (1976) findings could have been influenced by situational variables. It would be difficult to conceive of subjects remaining naive to the hypnotic focus of the study when such a great proportion of their total time was taken up with the administration of hypnotizability scales. Furthermore, no attempt was made to assess experimental demand characteristics, or to provide generalization data beyond that of changes on hypnotizability scales.

Electroencephalography and Sensory Deprivation

Engstrom's (1976) suggestion that restriction of sensory experience may be a variable basic to hypnosis was cited in Chapter I. Engstrom (1976) also noted that the "skills involved in becoming hypnotized may include a subject's predisposition to restrict sensory input because of lower levels of cortical arousal." Zubek (1973) reviewed the physiological effects of sensory and perceptual deprivation/restriction. The progressive slowing of electroencephalographic (EEG) activity was reported in the several studies mentioned. Exceptions exist in studies not included in the Zubek (1973) review. Kitamura, Tada and Kato (1969), for example, found dominant frequencies in two "representative subjects" to demonstrate "opposite (EEG) shifts" to each other in the course of sensory deprivation confinement.

The McGill University studies (Heron, 1957, 1961; Heron, Doane & Scott, 1956) were the first to reveal a slowing of EEG. EEG records were recorded for 6 subjects during and after 4 days of perceptual isolation. Occipital electrode placement was used. Data was analysed by period count method (Engel, Romano, Ferris, Webb & Stevens, 1944). A progressive slowing of mean alpha frequency (7½-13½ Hz) occurred with increasing duration of isolation. More slow activity was evident after 4 days that after 2 for all subjects. Effects were still present 3 hours after the termination of isolation. Gendreau, Freedman, Wilde and Scott (1968) replicated these findings using 7 days of isolation, but no post-deprivation follow-up measures were taken. Okyama and Kato (1966) also reported a "slowing of alpha" after 24 hours of sensory deprivation.

Zubek and Welch (1963) conducted a 7 day experiment with ten subjects in each of four groups. One experimental group was exposed to sensory deprivation, and the second was exposed to perceptual deprivation. One control group was ambulatory while the other was recumbent. EEG records were taken before and after each of the four procedures. Mean occipital EEG frequencies were obtained by the period count method in each of 200 1-second samples of artifact-free tracings. Records were analyzed blind with respect to the group from which they were drawn. All 20 subjects in the two experimental groups showed a significant decrease in mean frequencies, while neither control group showed any significant change. The perceptual deprivation group showed a significantly greater decrease in mean frequencies than the sensory deprivation group. It was also observed that both experimental groups showed an "excess" of theta (3½-7½ Hz) wave activity following deprivation. No significant difference was apparent between the experimental groups in theta wave density. [1]

EEG records were taken before, during and after isolation in a 14 day perceptual deprivation experiment (Zubek, 1964; Zubek, Welch & Saunders, 1963). Ten subjects were employed and occipital alpha frequencies were evaluated by the period count method. Data was collected at consistent intervals during and after isolation. Subjects showed a progressive decrease in mean alpha frequency with time in isolation. The mean decrease during the second week of deprivation was about twice as great as during the first week. Lebedinsky, Levinsky and Nefedov (1964) reported similar findings using extended experimental exposure periods up to 120 days. Social isolation rather than sensory or perceptual isolation was employed. EEG changes were still apparent 10 days after release from social isolation. "EEG abnormalities" were reported to be still apparent 2 months after the termination of a 2 month period of social isolation.

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1 Density - operationally refers to the frequency of the occurrence of a particular wave form (i.e. alpha, beta, theta, delta). In an EEG record, the term is used to avoid confusion with reference to actual sine curve wave frequency changes which may also occur. This use of the word "density" is common in current EEG literature.

EEG slowing has also been shown to occur after brief periods of deprivation. Marjerrison and Keogh (1967) exposed 18 male schizophrenics to only one hour of perceptual deprivation. A significant decrease in occipital alpha frequencies was reported. Kitamura, Hatayama and Maruyama (1970) assigned 24 undergraduate males to 5 hours of either 1) sensory overload, 2) sensory deprivation, or 3) movement restriction. Only the sensory deprivation group demonstrated a slowing of EEG. In a similar study Komatsu, Kawata and Shimada (1972) found a slowing of EEG during 3 hours confinement for both sensory overload and sensory deprivation groups.

Nagatsuka and Kokubun (1964) recorded EEG continuously for 9 subjects over 48 hours of perceptual deprivation. Motor activity was almost completely restricted. Consistent with the Canadian and Russian studies cited above slowing of EEG was reported. The study, however, failed to support the notion of "progressive" slowing of EEG activity as reported in the Zubek studies cited above. The findings of Nagatsuka and Kokubun (1964) were replicated by Ohyama, Kokubun and Kobayashi (1965), and by Sato and Kokubun (1965) using shorter perceptual deprivation periods.

Yoshino (1969) completed three sensory deprivation experiments of 3 hours duration each. The EEG findings were generally unclear except that the "EEG of 2 subjects were manifestly influenced by the conditions of the confinement." EEG results were also "inconclusive" in a sensory deprivation study by Ueno and Suzuki (1967).

Kitamura, Tada and Kato (1969) exposed 12 male university students to 24 hours of sensory deprivation. EEG data were "processed by the medical computer". The computer apparently produced time interval histograms. The histograms "revealed that dominant frequencies in 2 representative Ss showed opposite shifts to each other in the course of the confinement."

Several of the studies reported above, contradicting the findings of Zubek and his colleagues, were not included in Zubek's (1969) book reviewing research on sensory deprivation or in a later review chapter (Zubek, 1973). Zubek, Shepard and Milstein (1970) further investigated EEG after 1, 4 and 7 days of sensory deprivation using 10 male university students in each of the three groups. Each group showed a significant post isolation decrease in occipital alpha frequency, but contrary to the earlier Manitoba Lab studies (Zubek, 1964; Zubek, Welch & Saunders, 1963) there was no indication of a progressive decrease in mean alpha frequency.

Gendreau, Freedman, Wilde and Scott (1972) exposed 20 prison inmates to 1 week of solitary confinement. Significant changes in EEG frequencies parallelled those reported in laboratory studies. EEG frequency "declined in a nonlinear (in contrast to progressive) manner over the 7 day period." Control subjects showed no significant changes.

In another self-critical re-examination of earlier findings, Zubek, Hughes and Shepard (1971) used 161 male university students to compare the effects of sensory deprivation and perceptual deprivation on EEG activity. Deprivation exposure was 4 days. Results revealed that both sensory and percptual deprivation produced a significant decrease in occipital alpha frequency. Contrary to an earlier study (Zubek & Welch, 1963) "virtually no significant differences were observed between the two experimental groups." It was suggested that "these negative findings may be related to the shortness of the deprivation period."

The research on EEG alpha biofeedback training may be at least peripherally related to EEG slowing and alpha-theta increases in sensory deprivation studies. Recently, Plotkin (1979) reviewed the empirical research and conceptual perspectives on the development of "unusual experiential states during EEG alpha-biofeedback training". Sensory deprivation and other "complexly interrelated factors," were considered to account for the occurrence of the "alpha experience". Plotkin (1978) also investigated the effects of "long-term eyes closed alpha-enhancement training" on alpha amplitudes and experiential state. High and low levels of sensory deprivation were used with various EEG electrode placements.

The eyes closed "alpha-enhancement training" sessions involved "proportional auditory feedback of integrated alpha amplitudes" in ten 52 minute sessions. Consistent with the results of a study directed toward an analysis of biofeedback temperature training (Barabasz & McGeorge, 1976, 1978) the feedback of alpha did not result in learned enhancement of alpha density As in the Barabasz and McGeorge (1976) temperature study, increases in alpha were considered to be "partly due to the effects of suggestion". Plotkin (1978) accounted for "the occurrences of unusual experiences during alpha training" partly by the sensory deprivation conditions of the experimental procedures. It would seem that sensory deprivation might also account for the cases showing enhanced alpha.

In summary, it appears that sensory, perceptual, or even social deprivation/restriction results in slowing of EEG activity with consequent increases in alpha and theta densities. EEG slowing was shown by early studies to have a progressive, linear relationship to time in deprivation but the majority of more recent studies have failed to support this notion. A few investigations have pointed toward significantly greater EEG slowing effects for perceptual versus sensory deprivation but these difference in effectiveness apparently disappear when shorter deprivation periods are used. Both long and short periods of sensory or perceptual deprivation appear to significantly enhance the production of lower EEG frequencies and these effects seem to persist for some time after termination of deprivation.

EEG Alpha and Hypnotizability

Hilgard and Hilgard (1975, p.11) found "imaginative involvements" developed in childhood to relate to high hypnotizability. This finding was viewed to be consistent with studies of brain function showing a positive correlation between EEG alpha density and hypnotizability. Hilgard (1979a) noted "that efforts to define the hypnotic condition physiologically have not been successful." There has, in fact, been some progess in this area (Akpinar, Ulett & Itil; 1971; Jovanovic, 1979; Sabourin, 1980; Serafetinides,1968), but attempts might never be entirely successful. Subjects in hypnosis can be relaxed or engaged in strenuous esercise, they may be experiencing little emotion or may be emotionally aroused. Physiological measures are more likely to react to these behaviours than to anything specific to hypnosis (Hilgard, 1979a). Since these limitations need not apply to the psychophysiological assessment of hypnotizability, Hilgard noted, "there is no reason why the more hypnotizable person may not be distinguishable in some (psychophysiological) manner from the less hypnotizable". Research indicating a possible genetic component to hypnotizability (Morgan, Hilgard & Davert, 1970) makes this even more likely. Furthermore, the demonstrated interrelationships between sensory restriction with the slowing of EEG and "skills involved in becoming hypnotized" converge on the direct evidence of correlation between hypnotizability and EEG (Engstrom, 1976).

Several studies have been conducted investigating the possibility that hypnotizable persons would have naturally higher EEG alpha densities. The literature is about equally divided between studies supporting a positive correlation between subjects' waking alpha density and those failing to support such a correlation.

London, Hart and Leibovitz (1968) drew 8 high and 25 low susceptibility subjects from 125 volunteers for a "brainwave and hypnosis study". The Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1962) was used and EEG alpha was measured one week later. The high susceptibility subjects generated alpha for a mean of 42.3 seconds per minute while "resting" awake with eyes closed. The low susceptibility subjects generated alpha for only 24.0 seconds per minute. This difference was significant ($p < .005$) supporting a relationship between EEG alpha density and hypnotizability.

Nowlis and Rhead (1968) employed 21 volunteer university subjects who had been tested for hypnotic susceptibility on both Forms A and C of the Stanford Hypnotic Susceptibility Scale. Subjects "rested" with eyes closed in the darkened experimental room. A significant correlation of .70 was found between EEG alpha density and hypnotic susceptibility scores.

Bakan and Svorad (1969) "recruited" 12 volunteer university student subjects. Hypnotic susceptibility was assessed with the Stanford Hypnotic Susceptibility Scale Form C. Eyes closed resting

EEG alpha density correlated an average of .715 over eight trials with susceptibility.

Engstrom, London and Hart (1970) investigated EEG alpha feedback training and hypnotic susceptibility. Since the training for hypnotic susceptibility was the major focus of the study 30 subjects with scores of 7 or below on the Harvard Group Scale of Hypnotic Susceptibility were selected from 180 volunteers. Subjects used in the study were also tested on Form A of the Stanford Hypnotic Susceptibility Scale. Hypnotic susceptibility and EEG alpha density correlated .79 before biofeedback "alpha training" and .65 after training.

Morgan, McDonald and MacDonald (1971) studied differences in bilateral alpha activity as a function of experimental task in a sample of 10 high and 10 low susceptibility subjects. University students were aware only that they had volunteered for a "hypnosis and EEG study". Hypnotizability was tested using the Stanford Hypnotic Susceptibility Scale Form A. The study was not aimed at a correlation between alpha density and hypnotizability, however, Dumas (1977), obtained the raw data and completed a post hoc analysis. The usual baseline alpha EEG data was not available but the non-baseline alpha correlated .30 with hypnotizability. The correlation, although not significant, might be considered to indicate a trend. Given the focus of the experiment it would seem quite unlikely for demand characteristics to have postively influenced the correlation.

Morgan, MacDonald and Hilgard (1974) tested the EEG alpha-hypnotizability correlation directly. Twenty-six informed volunteers were tested for hypnotizability using 8 of the 12 standard items of the Stanford Hypnotic Susceptibility Scale Form C. The scale was shortened to fit into a 1 hour testing session. Occipital alpha was processed on-line for eyes open and eyes-closed resting baselines. Highly hypnotizable subjects showed significantly more alpha activity compared to low hypnotizables both outside of hypnosis and within it, except for the eyes-open baseline and eyes-open measures following release from amnesia. High hypnotizables showed higher integrated amplitudes of alpha. This finding was viewed as suggesting that overall production of alpha might be "positively related to the particular cognitive style that characterizes the person who is able to experience hypnotic phenomena."

Edmonston and Grotevant (1975) reported two experiments investigating hypnotizability and EEG alpha density. The first experiment employed university student subjects who volunteered on the basis of interest. The second experiment employed university students "coerced" to participate in the study. EEG alpha was measured using "right hemisphere" electrode placements for experiment 1, and "occipital to prefrontal areas on the right side" for experiment 2. Hypnotizability was measured using the Barber Susceptibility Scale (Barber, 1965) for experiment 1 and the

Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1962) for experiment 2. Neither experiment found a significant relationship between alpha density and hypnotizability in either eyes-open or eyes-closed conditions.

Galbraith, London, Leibovitz, Cooper and Hart (1970) employed 59 university student subjects who volunteered for a "study of brain waves" following administration of the Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1962). Full spectrum EEG data was recorded on magnetic tape and computer analyzed to determine EEG spectral parameters most related to hypnotic susceptibility. Electrodes were placed at a number of sites apparently consistent with the International 10-20 system. The most predictive EEG parameters were from the occipital areas during conditions of visual fixation, while the most predictive frequencies were from the slow frequency (5-8 Hz) range. Specific correlations with the Harvard Group Scale were not computed but the final regression equation, based on combinations of EEG specta, predicted .57 of the Harvard Group Scale. The study showed that EEG, as measured by spectral analysis techniques, is significantly related to hypnotic susceptibility. The results were viewed as supporting and extending the findings of Nowlis and Rhead (1968).

Evans (1972, 1979, p. 150-155) reported on unpublished data collected at the Unit for Experimental Psychiatry, Pennsylvania Institute. "Resting" EEG alpha baseline measures were available from 139 volunteer students who had independently participated in hypnosis experiments. Subjects had originally been tested for hypnotizability on the Harvard Group Scale and the Stanford Scale (Form C). Subjects of medium susceptibility were included. No details were provided on how the EEG measures had been obtained. No significant relationship between hypnotic susceptibility and alpha frequency amplitude or density was found.

Dumas (1975) "invited" 18 subjects to participate in a "biofeedback" experiment on the basis of their combined Stanford Scale (Form C) and Harvard Group Scale scores. Subjects were not informed of the selection criteria or of the hypnotic focus of the study. Details of the EEG measures were not reported but measures were taken throughout the biofeedback experiment. No resting EEG baseline was obtained. No significant correlation between EEG alpha and hypnotizability was found.

Dumas (1976) "invited" 18 subjects to participate in a "biofeedback and hypnotizability" study on the basis of their Harvard Group Scale scores. Before experimental procedures were initiated all subjects were fully briefed as to the nature of the study and previous findings on EEG and hypnotizability. "Resting" EEG alpha baselines were obtained. No significant correlation was found between EEG alpha and hypnotizability.

Cooper and London (1976) recorded EEG passing through a 5-17 Hz filter (a wide range including theta, alpha & beta frequency bins, possibly wider than the specified 5-17 Hz because of filter roll-off characteristics) in 35 children ($\bar{x}$ age = 10 yrs.) whose parents volunteered. The study was referred to as a "brainwave, hypnosis and personality study in which both parents and children would participate." The Children's Hypnotic Susceptibility Scale (London, 1963) was adminstered after EEG measures were obtained. Eyes open "alpha" density (quotes used because of the unusually wide band width accepted) correlated significantly ($p < .05$ on a one tailed test) with hypnotizability scores. Eyes closed "alpha" density was not significantly correlated with hypnotizability. The two correlations are, however, not significantly different from each other.

Crosson, Meinz, Laur, Williams and Andreychuk (1977) investigated EEG alpha training and hypnotic susceptibility with emphasis on baseline techniques. Stanford Scales (Forms A & B) and the Harvard Group Scale were employed with university student volunteers. Occipital alpha (filtered 8-13 Hz > 15 microvolts) was processed by biofeedback apparatus. Considerable attention was given to establishing adequate EEG alpha baselines but only eyes open procedures were used. Hypnotic susceptibility was not a significant dimension in alpha feedback training and the previously reported relationships between alpha density and hypnotic susceptibility were not generally supported. A significant correlation between alpha density and hypnotic susceptibility was, however, found when computation was based on the highest period of alpha during baseline.

On the basis of a critical review of the experimental literature, Dumas (1977) concluded that the only consistent covariate of the EEG alpha-hypnotizability correlations was the method by which subjects were selected. Dumas' (1977) summary Table 1 is reproduced here.

TABLE 1

ALPHA-HYPNOTIZABILITY CORRELATIONS AS A FUNCTION OF SUBJECT SELF-SELECTION

(From Dumas, 1977)

Experiment	Correlation	n
Volunteer Subjects		
Nowlis & Rhead, 1968	.70	21
Bakan & Svorad, 1969	.72	12
Engstrom, 1970	.56	30
Morgan et al., 1971	.30	20
Morgan et al., 1974	.47	26
Edmonston, 1975	.22	?
Invited Subjects		
Galbraith et al., 1970	none	59
Evans, 1972	-.02	48
Grotevant, 1975	.14	10
Dumas, 1975	-.01	18
Dumas, 1976	-.09	17
Cooper & London, 1976	-.09	35

Considering the results as presented in Table 1 Dumas (1977) concluded that in experiments where the sample consisted of non-naive volunteers, there was a significant correlation, while investigations using invited subjects or subjects unaware of the experimental focus revealed no correlation. A correlation results when subjects volunteer for a "brainwave and hypnosis" study, but no such relationship is evidenced when subjects are drafted. Dumas' Table 1 seems to support the conclusion that subject self-selection, based on the invitation to participate voluntarily versus coercion is primarily responsible for alpha-hypnotizability correlations.

While the alpha-hypnotizability correlation research is contradictory Dumas' (1977) attempt to characterize these vagaries on the basis of subject selection is not as straight forward as his table (Table 1) might indicate. Referring to Table 1 and the investigations surveyed in the present section several inconsistencies become apparent.

Dumas' Table 1 shows a correlation of ".56" for the Engstrom, London and Hart (1970) study, the actual study reported a correlation of .65 after biofeedback training and .79 before training.

The Morgan, McDonald and MacDonald (1971) study result given in Table 1 was not reported in the original study but computed by Dumas (1977) in post hoc analysis based on a non-standard EEG alpha baseline.

Table 1, and its interpretation by Dumas (1977), shows "Edmonston, 1975" as revealing a .22 correlation between alpha and hypnotizability. Apparently, the reference is actually to Edmonston's experiment in the Edmonston and Grotevant (1975) investigation. While it is true that the subjects were volunteers the .22 correlation was not significant and was viewed by Edmonston and Grotevant as failing to support the alpha-hypnotizability correlation notion rather than supporting it as in Dumas' (1977) tabular interpretation.

Table 1 shows "none" under the correlation column for Galbraith, London, Leibovitz, Cooper and Hart (1970). It would seem reasonable for a reader to interpret "none" as meaning no correlation was found, thereby, supporting Dumas' (1977) conclusion for invited subjects. Actually, "none" refers to the fact that Galbraith et al (1970) did not report a correlation. Review of the Galbraith et al (1970) study reveals relatively strong regression equation support for a relationship between EEG and hypnotizability rather than support for the Dumas (1977) conclusion.

Table 1 lists "Grotevant, 1975" and a correlation of .14 for invited subjects. This apparently refers to the Grotevant experiment in Edmonston and Grotevant (1975) investigation. Interestingly, this non-significant correlation of .14 is used to support Dumas' (1977) conclusion for invited subjects, yet, it is not significantly different from the "Edmonston, 1975" correlation of .22, (also not significant), Dumas (1977) used to support a correlation for volunteer subjects.

Cooper and London (1976) were reported in Dumas' (1977) Table 1 as showing a non-significant negative correlation between alpha and hypnotizability. The actual Cooper and London (1976) study reported a significant positive correlation between alpha and hypnotizability, albeit with a one-tailed test.

In summary, the conclusion that subject self selection accounts for EEG alpha hypnotizability correlations (Dumas, 1977) may not be as clearly supported by the data as it might appear in the Dumas (1977) review. Nonetheless, it seems that Dumas (1977) has revealed the self-selection variable, and possibly the subject naivete variable, as worthy of special consideration in studies dealing with EEG alpha and hypnotizability.

Summary Comment on the Literature Review

The review of the related literature further supports the need to explore the questions raised in Chapter 1 (p.6) and to test the hypotheses (p. 14-16). Research on sensory deprivation, EEG and suggestibility has been conducted outside of those investigations specifically dedicated to the modification of hypnotizability. These investigations, presumably, would be less likely to have produced EEG and suggestibility shifts because of demand characteristics, yet the findings are generally consistent with sensory deprivation studies specifically aimed at modifying hypnotizability. The findings in both domains of research effort may be conceptualized within the hypnosis theories discussed in Chapter I. Enhancement of hypnotizability investigations completed, to date, have failed to control significant variables which may have accounted for the apparent findings. The question of the effects of subject self-selection and the importance of maintaining naivete of subjects has been raised in the context of EEG hypnotizability studies. This suggests to the present investigator that sensory deprivation/restriction effects on suggestibility must first be studied in a non-laboratory setting which assures, as absolutely as possible, maintenance of subjects' naivete with respect to the hypnotic focus of the study. If hypnotizability increases, and EEG alpha densities increase in correlation with susceptibility, a controlled laboratory study could be meaningful.

Chapter III

PHASE I INVESTIGATIONS

EEG Alpha, Electrodermal Arousal and Hypnotizability in Antarctic Isolation.

The investigations reported in this chapter were conceptualized as prerequisite to laboratory controlled study of the effects of sensory deprivation/restriction on hypnotizability. The research reported here was designed to test *General Hypnotizability Hypothesis #1* (Chapter 1, p.14) and *Hypotheses Relating to EEG, #8, #9 & #10* (Chapter 1, p. 15 & 16). The experimental literature specifically relevant to the investigations reported in this chapter is briefly resurveyed to minimize the need to refer to Chapter II. A few relevant references, beyond the scope of Chapter II, have also been added.

Introduction

The slowing of EEG activity has been reported in several studies of the effects of prolonged sensory and perceptual deprivation or restriction. The extent of alpha frequency slowing has been shown to be dependent upon deprivation conditions (Gendreau, Freedman, Wilde & Scott, 1968, 1972; Heron, 1957, 1961; Heron, Doane & Scott, 1956; Kitamura, Hatayama & Maruyama, 1970; Komatsu, Kawata and Shimada, 1972; Marjerrison & Keogh, 1967; Nagatsuka & Kokubun, 1964; Ohyama, Kokubun & Kobayashi, 1965; Okyama & Kato, 1966; Sato & Kokubun, 1965; Zubek, 1964; Zubek, Hughes & Shepard, 1971; Zubek, Shepard & Milstein, 1970; Zubek & Welch, 1963; Zubek, Welch & Saunders, 1963). Engstrom (1976) suggested that the restriction of sensory experience may be a variable basic to hypnosis. He noted that skills involved in becoming hypnotized may include the subject's predisposition to restrict sensory input because of lower levels of cortical arousal. Even in active-alert hypnotic induction (Banyai & E.R. Hilgard, 1976), focused attention seems to be a common characteristic. In this study, it was noted that although eyes remained open in alert induction, the gaze appeared unfocused, as though the subject was staring at some distant object. Ss reported the ability to "tune other things around me out (p.222)."

Several studies have shown a significant, positive relationship between waking eyes closed alpha density and hypnotizability (Bakan & Svorad, 1969; Engstrom, London & Hart, 1970; London, Hart & Leibovitz, 1968; Morgan, MacDonald & Hilgard, 1974; Nowlis & Rhead, 1968). Crosson, Meinz, Laur, Williams & Andreychuk (1977) found a significant correlation between eyes open alpha and hypnotic susceptibility, but only when computation was based on the highest period of alpha during baseline. Other studies have failed to support a positive correlation between alpha and susceptibility (Dumas, 1975, 1976; Dumas & Morgan, 1975; Edmonston & Grotevant, 1975; Evans, 1972). Alpha rhythm has typically been recorded from single sites only. Electrode placements have been inconsistent and have ranged from frontal to occipital sites.

On the basis of a review of the literature, Dumas (1977) concluded that the only consistent covariate of the alpha-hypnotizability correlation was the method by which subjects were selected. In experiments where the sample consisted of non-naive volunteers, there was a significant correlation, while investigations using invited subjects or subjects unaware of the experimental focus found no correlation. A correlation results when subjects volunteer for a "brainwave and hypnosis" study, but no such relationship is evidenced when subjects are drafted. It was concluded that subject self-selection, based on the invitation to participate voluntarily versus coercion is primarily responsible for alpha-hypnotizability correlations. The operation of subject self-selection might be viewed as a variable related to personality.

In contrast to the findings of environmental influences on alpha EEG as noted in the several studies cited earlier, and Engstrom's (1976) suggestion that sensory restriction may be basic to hypnosis, the review by Dumas (1977) reveals the variable of subject self-selection according to the invitation to hypnosis. The Dumas (1977) finding is of particular interest when viewed in the context of earlier research on hypnotic susceptibility and personality. Numerous studies have been conducted using scales such as the California Psychological Inventory (Gough, 1956), the 16 Personality Factor Questionnaire (Cattell & Eber, 1949), the Guilford-Zimmerman Aptitude Survey (Guilford & Zimmerman, 1947), and the Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1942). The studies have been reviewed by Hilgard (1965), Barber (1969), and Engstrom (1976). Generally, no significant relatedness between personality factors and hypnotizability was found. The few significant correlations yielded were of very limited predictive utility. Hilgard (1965) suggested that the personality inventories used may not adequately sample content areas related to susceptibility. Tellegen and Atkinson (1974) cited the evidence that such purportedly multidimensional scales are saturated with only the dimensions of Stability versus Neuroticism and Introversion versus Extroversion. A third personality variable "Absorption" - or the imperviousness to distracting events - was found to have a low but consistent correlation with hypnotizability.

In summary, Dumas (1977) has concluded that subject self - selection, based on the invitation to participate voluntariy, versus coercion, such as by class requirements, is primarily responsible for alpha-hypnotizability correlations. Alternatively, Engstrom (1976) suggested that the demonstrated interrelationships between sensory restriction, an environmental variable, with slowing of EEG, and skills involved in becoming hypnotized converge on the direct evidence of correlation between hypnotizability and EEG. As noted in Chapter II, research indicating a possible genetic component to hypnotizability (Morgan, Hilgard & Davert, 1970) makes the possibility of such a correlation even more likely.

The purpose of the central investigation reported in the present chapter was to test the hypothesis (Chapter I, Hypothesis #1, p.14) that hypnotizability will be significantly enhanced for subjects exposed to the sensory and perceptual restriction of prolonged Antarctic isolation. In light of the literature reviewed above and in Chapter II it seemed appropriate to advance the following alternative and conflicting a priori hypotheses:
a) On the basis of Dumas' (1977) findings, drafted subjects who are naive with respect to the focus of the research will not demonstrate a significant EEG alpha density correlation with hypnotizability either prior to or following the sensory/perceptual restriction of prolonged Antarctic isolation (Chapter I, Hypothesis #8, p.15), b) On the basis of Engstrom's (1976) findings drafted subjects who are naive with respect to the focus of the research will demonstrate a significant EEG alpha density correlation with hypnotizability prior to and following the sensory/perceptual restriction of prolonged Antarctic isolation (Chapter I, Hypothesis #9, p. 16).

An additional purpose of the investigations reported in the present chapter was to determine whether or not alpha-hypnotizability correlations could be enhanced for invited subjects by omitting those portions of EEG records that are coincident with skin conductance indices of arousal. Psychophysiological arousal, vigilance, or even relatively simple cognitive tasks have been shown by numerous studies to be incompatible with alpha production (Enslein, Beatty, Grossberg, Cohen, Chapman, Vidal, Rebert, 1975). Electrodermal response indices have been found to be negatively correlated with alpha production (Pelletier & Peper, 1977). Crosson, Meinz, Laur, Williams and Andreychuk, (1977) suggested that arousal responses in a novel environment, soon after having electrodes attached, could block alpha activity. It could be expected that naive or invited subjects might demonstrate greater psychophysiological arousal during experimentation than informed volunteers. It was hypothesized that Dumas' (1977) findings of no correlation between alpha density and hypnotizability for drafted naive subjects can be accounted for by suppression of subjects' typical eyes closed alpha due to arousal. Specifically, drafted subjects who are naive with respect to the focus of the experiment, will demonstrate enhanced EEG alpha density and hypnotizability correlations prior to and following Anatarctic isolation when portions of EEG records co-incident with skin conductance measures of arousal are omitted form the computation of EEG alpha density (Chapter I, Hypothesis #10, p. 16).

METHODOLOGY

Subjects

The invited subjects, naive with respect to the focus of the investigation, consisted of 9 of the 10 men wintering-over at Scott Base, Antarctica. The tenth man was unable to participate in the study due to logistics factors.[1] The subjects were told only that they were participating in a study of stability of various psychophysiological and psychometric responses. The sample, consisting mainly of scientific technicians, engineers, mechanics, and an electrician, was considered to be technologically oriented.

Since many studies of hypnotizability employ university students as subjects a preliminary investigation was conducted to compare the hypnotic susceptibility of the Scott Base subjects with that of university students. Scott Base subjects' pre-winter hypnotizability scores, on the instrument described later in this chapter, were found to be significantly lower ($p < .05$) on a Wilcoxon Contrast than the scores for a group of 34 upper level University of Canterbury students.

1. Scott Base winter-over personnel were tested before and after the Antarctic winter isolation, however, one subject was replaced by the Department of Scientific and Industrial Research after the pretesting was completed. Antarctic transport limitations made testing of the replacement man prior to isolation impossible.

Constraints and Investigative Setting

Scott Base, Antarctica provided one of the only field study situations in the world which includes non-laboratory sensory restriction over a prolonged period while affording, as absolutely as possible, the opportunity to maintain naivete of an adequate sized sample of drafted subjects. The unique advantages of this setting also involved logistic problems.

Scott Base is a New Zealand, Antarctic station located near Mount Erebus and McMurdo Sound, 1300 km from the South Pole. All apparatus had to be flown to Antarctica by Hercules C-130 ski equipped aircraft, as no appropriate laboratory facilities existed there. Considerations of cost and logistics took precedence over factors that would normally be paramount in designing an experiment. Only 9 men did the full tour of duty lasting just over 12 months on the base. All procedures chosen had to be simple, and replicable in all controllable details, when adminsitered in the first session in December and again the following year in October. The ambient conditions outside the base were, in the December testing, average temperature -2.5^{o}C and 24 hours of daylight per day (early Antarctic summer), and in the October testing, average temperature -30^{o}C, 20 hours daylight per day. During the intervening winter, with three months continuous darkness, the outside temperature dropped considerably lower (to -65^{o}C) and parts of the base became submerged under snow drifts. Only part of the base complex is heated (about +15^{o}C) and humidified (about 30% relative), so all subjects were exposed to varying degrees of protracted cold and very low or negligible humidity in their work.

Despite the availability of books and weekly films individuals in such monotonous Antarctic group settings experienced some of the same subjective responses as do individuals in the more extreme conditions of sensory deprivation (Haythorn, 1973; Myers, 1969; Schultz, 1965; Smith, 1969). "Men are subjected to sensory and perceptual isolation, circadian cycle disruptions, low humidity and extreme cold" (Brooks, Natani, Shurley, Pierce & Joern, 1973). Cold temperature working conditions cause anosmia which serves to restrict olfactory sensory input to indoor station odours. It has been noted (Barabasz & Gregson, 1979) that this form of Antarctic sensory restriction results in frequent reports of "profound increases in sensitivity upon return to New Zealand '...when I got back I could smell everything...all kinds of things in the air at once.'" Both laboratory olfactory deafferentiation (Beteleva & Novikova, 1961) and Antarctic olfactory restriction (Barabasz & Gregson, 1979) has been demonstrated to produce significant EEG evoked potential shifts.

Apparatus

Eight channels of EEG activity were simultaneously recorded on a San-Ei 1A61 electroencephalograph[1] at a sensitivity of 2.5mm/50

[1]<u>Specifications and calibration</u>: Max sensitivity-5mm deflection/25μV input; Amplification circuitry-negative feedback using integrated circuit & FET; Channel spacing-15mm; Linearity ±1%; Frequency response 3db down, up to 60Hz; Hum filter -20db or better; Common mode rejection 80db (10,000:1); Internal noise- 3μV peak-to-peak referred to input; Calibration- 50μV; Electrode impedance measuring system-AC measurment; Power-AC mains, 50Hz; Dimensions-576(w)x180(h)x308(d)mm; Weight-18Kg.

microvolts. A paper speed of 3cm/second was used with the ninth channel time constant set to 0.3. Recordings were monopolar employing the left and right earlobes for reference sites. Electrodes were placed in compliance with the International 10-20 system at left and right frontal (F3 and F4), left and right temporal (T3 and T4), left and right parietal (P3 and P4), and left and right occipital (01 and 02).

Beckman silver/silver chloride bipotential hat electrodes were used for frontal, earlobe and earthing sites using Beckman electrode gel. Beckman electrodes were placed with double sided adhesive washers. Wire scalp electrodes of local construction, were placed with bentonite paste for temporal, parietal and occipital sites. Electrode type/placement combinations were formulated to maximize signal to noise ratio on the basis of a preliminary experiment with 8 inmate volunteers from Paparua Prison, Christchurch, New Zealand. Several electrode types and various pastes were tried in this preliminary experiment. The very limited (3.5 sq. metre) (see Appendix for photos) Antarctic working space was also simulated at Paparua Prison for experimenter practice. Electrode to skin contact conditions were monitored simultaneously for all sites on the light emitting diode display board of the San-Ei 1A61. Maximum acceptable scalp to reference electrode resistance was 15k ohms. The resistance checking procedure also served to depolarize the electrodes. All electrode placements were completed by the present investigator to maximize consistency of site location.

Skin conductance (SC) was also monitored during EEG recording sessions. Beckman silver/silver chloride biopotential hat electrodes were attached to the medial phalanx (Edelberg, 1967) on the volar surface of each S's second and third digits following the Barabasz (1977) standardized procedure using double sided adhesive washers. The SC measures were amplified by a 76441 conductance amplifier removed from a Lafayette Instruments Barabasz Desensitization Quantifier (Lafayette 76100-30). Recordings were made on a Lafayette 76012 Datagraph. The SC sensitivity was set at 0.1 μmho/cm. Subject voltage was constant at 0.2 V D.C. Chart speed was set at 2.5mm/second.

Hypnotizability Instrument

In order to preserve the naivete of subjects for the pre- and post winter measures, the Barber Suggestibility Scale (BSS) of Barber and Glass (1962) was selected as the measure of hypnotizability. In contrast to other reliable scales, such as the Stanford Hypnotic Susceptibility Scale, Forms A and B (Weitzenhoffer & Hilgard, 1959), Form C (Weitzenhoffer & Hilgard, 1962), Stanford Hypnotic Clinical Scale (Morgan & J.R. Hilgard, 1975) or the Harvard Group Scale of Hypnotic Susceptibility, (Shor & E. Orne, 1962), the BSS can be administered without induction of hypnosis. On the basis of a pilot study (Barabasz, 1976) employing a Solomon four-group design, it was determined that even the use of the BSS resulted in significant alteration of subjects' awareness of the hypnotic focus of the study. Since it was the aim of the present study to maintain naivete of subjects, the BSS was not used in its entirety. Items (1) Arm Lowering, (2) Arm Levitation, and (4) Thirst Hallucination were found to correlate significantly with full scale suggestibility scores while showing no significant influence on Ss naivete regarding focus of the measures. Items (1) and (2) were scored on the basis of inches of arm movement (Barabasz, 1976).

The present study employed items (1) and (2) of BSS as described above. Item (4) was modified by eliminating the portion which asks the subject to imagine himself in the hot sun for hours. On the basis of face validity, it was assumed that the hot summer sun image would not be relevant for wintering-over staff in the twelfth month in Antarctica. At the time of posttesting, indoor passageways at Scott Base were at an ambient temperature of -32^{o}C. Item (4) was limited to the scoring of the swallowing response upon imagination of the drinking of a refreshing glass of water.

The modified BSS and the Stanford Hypnotic Clinical Scale (SHCS) of Morgan and J.R. Hilgard (1975) were administered to 34 upper level students enrolled at the University of Canterbury, New Zealand. A rank order correlation between the measures was significant ($r = .37$, $p<.05$). Broad (1979) independently found a significant correlation ($r = .42$, $p<.05$) between the modified BSS and SHCS with an N of 20.

Procedure

All tests were conducted at Scott Base, Antarctica. A previous study (Simmonds, 1974) demonstrated the logistic difficulties inherent in attempting to test men before they departed from New Zealand and after they returned. Hypnotizability, EEG, and SC data were collected 8 weeks after Ss arrived at Scott Base and 10 months later. The 8 week pre-data collection period allowed for arrival novelty effects and general acclimitization to Antarctic conditions. Psychophysiological results could otherwise have been confounded by the shallower breathing people adopt in cold climates (Barabasz & Gregson, 1980). Shallower breathing may change blood CO_2 levels which could lead to unknown central nervous system (CNS) effects. The period also allowed for adjustment to low humidity and resultant skin hydration effects which could affect skin conductance (SC) responses. The actual wintering period is over 7 months duration and there are no flights or ships during this time. The only contact with the outside world was by intermittent radio communication. The second testing immediately followed the period of isolation during the long, dark Antarctic winter.

Following attachment of EEG and SC electrodes, subjects were helped on to a bed in the small sick bay room of the base. An exhaust fan served to mask extraneous noises. Each subject's maximum SC level was established following standardized procedure; detailed descriptions are reported elsewhere (Barabasz, 1977; Lykken & Venables, 1971; Prokasy & Raskin, 1973). The subjects were then asked to close their eyes and relax to the best of their ability while EEG and electrodermal data were recorded.

A relatively long recording period, typically 25 minutes, was chosen to help correct for possible novelty effects on alpha production. Eye movement muscle artifacts in the frontal records were used to help correct for onset of sleep. Sleep onset occurred for the same three subjects in pre-and post-winter testing sessions. In these instances, subjects were awakened verbally, and their recording periods were extended to allow for a 3- to 4-minute period after arousal.

After the recording period, electrodes were removed and hypnotizability measures were administered. Without attempted induction of hypnosis, subjects were then told that the remaining tests were all tests of imagination. The better you can imagine and the harder you try, the more you'll respond. Try as hard as you can to concentrate, and to imagine the things I tell you to (Barber & Glass, 1962, p.222)."

Following all data collection, informal interviews were conducted with all subjects prior to their arrival back in New Zealand. While conducted informally with largely non-directive interviewing leads, the interviews were aimed at determining whether or not naivete had been maintained and to collect information for another project (Barabasz, 1980d).

Scoring

The EEG alpha (8-13 Hz greater than approximately 20 μV) data for all eight channels was hand scored using a San Ei precision frequency templet. As is typical with such standard and widely used scoring templets, a paper speed of 3 cm/second is assumed in the design of the templet. Graduations for the relevant frequency bins, in this case, alpha 8-13 Hz, are etched on a clear plastic sheet. The sheet is then placed over the analog EEG record and shifted manually until a set of graduations aligns with the sine curve peaks. Each set of graduations represents a particular EEG frequency so it is a simple task to determine the frequency of specific EEG output. The identification of alpha in analog EEG records of this type can be accomplished by even the relatively inexperienced by use of the naked eye only. Use of the frequency templets provides even greater accuracy and the achievement of interrater reliability of .95 on essentially artifact free analog records. Each one second period of record was considered separately using the one second graduations provided on the EEG recording paper. Consistent with standard practice in hypnosis, EEG alpha research (Crosson, Meinz, Laur, Williams & Andreychuk, 1977) percentage of alpha in seconds time was scored. Two independent scorers who were blind to the purpose of the investigation were used. Records were scored for total percent-alpha and for total percent alpha less the portion of each record during which subjects demonstrated SC arousal responses and less the 3-4 minutes following awakening for subjects exhibiting sleep onset.

Since previous studies (see literature survey) were not consistent in electrode site choice, all channels except frontals were averaged in determining total percent-alpha. Frontal data was omitted because of between-scorer inconsistency apparently related to artifact interpretation. Scoring the remaining channels involved few interrater discrepancies (reliability .95^{+}). Data with 100% agreement between raters was accepted for further analysis. An SC arousal response was operationally defined as a pen deflection amounting to 50% or greater of subject's maximum SC response based on the Lykken and Venables (1971) startle response procedure.

The three hypnotizability tests were scored on a 0-3 point basis for each item. Arm lowering and arm levitation were scored 1 point for 4"-8" response, 2 points for 8^{+}"-12" and 3 points for 12^{+}" and over. Consistent with Barber and Glass (1962) the response was measured by placing a ruler near the subject's hand at the beginning of the suggestions and noting degree of displacement at the end of the second suggestion period (see Appendix 6). The swallowing response/drinking of water item was scored 1 point for a single swallow or one swallow combined with mouth movements. An additional point was given if the subject reported that it "actually felt like I was drinking a glass of water" during post-test questioning. As noted earlier the concurrent validity of this instrument was demonstrated by a significant ($r=.37, p<.05$) correlation with the Stanford Hypnotic Clinical Scale (SHCS) (Morgan & Hilgard, 1975) using 34 subjects. The validity of the instrument was further supported when Broad (1979) independently found a significant correlation with the SHCS ($r=.42, p<.05$) using an N of 20.

RESULTS

The subjects' prewintering-over and postwintering-over hypnotizability scores were analyzed using a Wilcoxon Matched-Pairs Signed-Ranks test. A significant increase in hypnotizability was found (Wilcoxon T = 3; Ns - R = 8, $p < .05$). Six of the 9 subjects showed clear and obvious increases on all three test items.[1] Because of the need to maintain naivite of subjects in this study, no further criterion measures were obtained in an effort to determine meaningfulness of changes in hypnotizability. Rank order correlations were performed for hypnotizability scores and percent-alpha, and for hypnotizability and percent-alpha omitting portions of EEG record coincident with SC arousal indices. The results for pre- and post-wintering-over periods appear in Table 2.

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[1]The non-parametric statistical test was employed because the test scores do not meet interval data assumptions. The use of average increases or means as descriptive statistics for such data is inappropriate. While means are meaningless for such data, for interest they were as follows - pre-winter $\bar{x}=2.83$ and post-winter $\bar{x}=3.22$.

TABLE 2

PERCENT-ALPHA AND HYPNOTIZABILITY CORRELATIONS FOR ANTARCTIC WINTERING-OVER PARTY

Period	Total Percent-Alpha	Percent-Alpha Corrected for SC Arousal-Periods
Prewinter Isolation	.21	.61*
Postwinter Isolation	.58*	.86**

* $.05 < p < .10$

** $p < .01$

The results presented in Table 2 show a significant ($p \leq .01$) correlation between percent-alpha per record, less periods of SC arousal, and hypnotizability for Ss exposed to Antarctic wintering-over isolation. Correlations for prewinter SC corrected alpha and postwinter uncorrected alpha showed a tendency toward significance ($.05 < p < .1$). No significant correlation was demonstrated for the prewinter total percent-alpha data.

Parametric statistical tests are used in virtually all percent-alpha and hypnotizability studies (see literature survey and Crosson, Meinz, Laur, Williams & Andreychuk,1977). Pre- versus post wintering-over percent-alpha scores and SC corrected percent-alpha scores were compared by a t-test for matched samples. The results apprear in Table 3.

TABLE 3

PERCENT- ALPHA DENSITY *t* TEST RESULTS FOR WINTERING-OVER PARTY

Contrast	*N*	$\bar{X}$ Percent-Alpha	*S.D.*	*t* Value
Prewinter Total Alpha	9	32.00	15.44	
versus				4.78*
Postwinter Total Alpha	9	44.22	18.81	
Prewinter SC-corrected Alpha	9	38.33	17.17	
versus				3.53*
Postwinter SC-corrected Alpha	9	49.44	21.54	

*$p < .01$

The results presented in Table 3 show significant ($p < .01$) increases in alpha density for total percent-alpha and SC corrected percent-alpha following wintering-over isolation.

The t test results were subjected to Omega square analysis. An $\omega^2 = .54$ was found for the total alpha density comparison and an $\omega^2 = .39$ was found for SC corrected alpha density comparison. Both Omega square results showed a relatively high degree of statistical association from the data.

DISCUSSION

The present study supports the hypothesis that hypnotizability would be enhanced for subjects exposed to the sensory and perceptual restriction of prolonged Antarctic isolation (Chapter I, Hypothesis 1, p.14). A significant increase in EEG alpha density was also found after wintering-over isolation at Scott Base, Antarctica. The results appear to support the view that environmental factors or possibly their interaction with another personality factor, choosing to winter-over in Antarctica, can significantly influence hypnotizability and waking eyes closed alpha.

The study generally supports the hypothesis that drafted subjects naive with respect to the focus of the research would demonstrate a significant EEG alpha density correlation with hypnotizability (Chapter I, Hypothesis #9. p.16) while failing to support the alternative and conflicting hypothesis suggested by Dumas' (1977) findings (Chapter I, Hypothesis #8, p.15). The EEG alpha-hypnotizability correlation was most strongly supported for SC arousal corrected records both pre- and post- isolation while there was only a tendency ($p < .1$) to support the correlation as significant for uncorrected EEG records post isolation. It is of interest to note that had this study been limited to a simple total alpha density and hypnotizability measure for invited subjects - prior to wintering-over isolation - the results would have appeared to further support Dumas' (1977) findings. Such conditions were similar to those of the invited subject studies performed earlier.

Subjects were drafted for both pre- and post-testing sessions and the 10-month period between sessions seemed adequate to control for potential effects from pretesting. Informal interviews conducted with all Ss following all data collection failed to reveal any awareness of attitudinal change but preservation of naivete seemed to be confirmed. In posttesting, Ss' ability to recall aspects of the pretest was noted. The majority of Ss recalled "...putting wires or electrodes on the scalp," but failed to recall the "test of imagination."

The hypothesis that Dumas' (1977) findings of no correlation between alpha density and hypnotizability for drafted naive subjects could be accounted for by suppression of subjects' typical eyes closed alpha due to arousal was supported by the data. Subjects demonstrated enhanced EEG alpha density and hypnotizability correlations prior to and following Antarctic isolation when portions of EEG records coincident with skin conductance measures of arousal were omitted from the computation of EEG alpha density (Chapter I, Hypothesis #10, p.16). The Crosson et al (1977) suggestion that arousal responses could block alpha activity was supported. While the total percent-alpha and hypnotizability correlation approached significance in the postwintering-over testing period, the omission of portions of EEG record coincident with SC arousal indices appeared to greatly enhance this correlation. The SC correlation procedure also enhanced the prewintering-over correlation. Further enhancement of EEG alpha and hypnotizability correlations might be obtained by additional refinement of SC criteria of arousability. On the basis of postexperimental trials, it was also concluded that electrode placement at the left or right outer canthi would be more useful than the frontals for the detection of sleep onset by eye roll artifacts.

The Scott Base, Antarctica situation provided an ideal environment for restriction of sensory and perceptual input over time, while maintaining naivete of subjects with respect to the focus of the experiment. The possbility of conducting high quality multiple channel EEG measures in a cramped and electrically unscreened remote base has been demonstrated to be possible using modern equipment. While the Antarctic situation provided naive drafted subjects and prolonged sensory and perceptual deprivation it also limited the study to a pre-post design. While the various preliminary investigations mentioned could be completed with university student and prisoner subjects no genuinely comparable control group was available to contrast with the Antarctic isolates. The operation of sensory and perceptual restriction in Antarctica is recognized in the literature (Edholm & Gunderson, 1973; Natani & Shurley, 1974; Rasmussen, 1973), but outside of general description it is difficult to specify the parameters of such restriction. It seemed to the present investigator that further laboratory controlled research was required.

Chapter IV

PHASE 2 INVESTIGATIONS

Effects of Laboratory Controlled Sensory/Perceptual Deprivation on Hypnotizability

The investigations reported in this chapter followed those reported in the previous chapter and were designed to employ a number of controls not possible in the previous field study. The use of Orne's (1959) post experimental inquiry to assess demand characteristics and the use of pain tolerance to assess generalization of hypnotizability changes appear for the first time in research on the modification of hypnotic susceptibility. The research reported was designed to test General Hypnotizability Hypotheses #2 and #3 (Chapter I, p.14), and Conflicting Hypnotizability Hypotheses #4, vs #5, and #6 vs #7 (Chapter I, p.14 & 15). The experimental literature specifically relevant to the investigations reported in this chapter is briefly resurveyed to minimize the need to refer to Chapter II. A few relevant references, beyond the scope of Chapter II have also been added.

The view that hypnotic susceptibility is generally stable within subjects seems supported by the literature (As, Hilgard & Weitzenhoffer, 1963; Cooper, Banford, Schubot & Tart, 1967; Hilgard, 1979; Leva, 1974b; Levitt, Brady, Ottinger & Hinesley, 1962; Morgan, Johnson, & Hilgard, 1974; Perry, 1977; Shor & Cobb, 1968). High test-retest reliability of hypnotizability scores using the same and different hypnotists (Weitzenhoffer & Hilgard, 1959) as well as high correlations over hypnotizability tests with varying induction procedures and test items has been demonstrated (Hilgard, Weitzenhoffer, Landes & Moore, 1961; London, 1969; Shor, Orne & O'Connell, 1966).

Alternatively, hypnotizability has been viewed as modifiable (Diamond, 1977). There is evidence that significant enhancement can be achieved by a wide range of techniques; over fifty such studies were cited in Chapter II. Studies focusing on the investigation of sensory deprivation phenomena have shown increases in suggestibility independent of the research dedicated to the enhancement of hypnotizability (Fisher & Rubenstein, 1956; Jones & Goodson, 1959; Vernon, 1961, 1963; Vernon & Hoffman, 1956; Walters, Callagen & Newman, 1963; Walters & Quinn, 1960). Within the research dedicated to the enhancement of hypnotizability sensory/perceptual deprivation/restriction studies have shown promise in terms of significant effects and on the basis of theoretical accountability (King & Lummis, 1974; Leva, 1974b; Pena, 1963; Richie, 1976; Sanders & Reyher, 1969; Shor & Cobb, 1968;

Talone, Diamond & Steadman, 1975; Wickramasekera, 1969, 1970). These studies were reviewed in detail in Chapter II. In the most successful study reported to date, (Sanders & Reyher, 1969) significant and comparatively dramatic increases in Stanford Hypnotic Susceptibility Scale (Form A & B)(Weitzenhoffer & Hilgard, 1959) scores were found following six hours of sensory deprivation, or until clinical signs of deprivation, such as craving for stimulation, were evidenced. These findings were viewed as consistent with Reyher's (1964) psychophysiological theory of intrapsychic processes. (Reviewed in Chapter I). The Stanford Hypnotic Susceptibility Scale increases were, however, still present in later follow-up testing and this finding could not be adequately accounted for by the theory. Unfortunately, the specific demand characteristics of the instructions could have accounted for the follow-up findings. The theory remains to be tested.

Leva (1974b) criticised the use of the Stanford Hypnotic Susceptibility Scale because of its heavy loading of primary suggestibility (Hilgard, 1965) ideomotor items, despite Sanders and Reyher's (1969) findings that two of the three nonmotor items changed as much as the motor items. The Stanford Hypnotic Susceptibility Scale was contrasted with the Stanford Profile Scales (Weitzenhoffer & Hilgard, 1967) which are characterized by a lack of motoric items. Leva (1974b) attempted to control for instructional expectations present in the Sanders and Reyher (1969) study but used only five low susceptible subjects. Leva's results were consistent with Sanders and Reyher (1969) showing an increase in Stanford Hypnotic Susceptibility Scale Scores. As predicted, however, no such increases were found on the Stanford Profile Scales. The extent to which deprivation affects hypnotic performance was questioned in consideration of the greater item difficulty of the Stanford Profile Scales which involves items such as age regression.

Several additional methodological criticisms have been made of the studies purporting to modify hypnotic susceptibility. These criticisms were reviewed in Chapter II. Briefly, it appears that many modification studies have failed to control for or consider (1) plateau hypnotizability, (2) follow-up testing, (3) situational factors e.g. positive/negative motivational instructions-expectancy, (4) generalization data beyond that of hypnotic susceptibility test scores, (5) demand characteristics e.g. cues in the design and/or procedure which might communicate the experimenter's hypothesis and lead the subject to provide data confirming the experimenter's predictions. No modification study has provided generalization data beyond that of hypnotic susceptibility test scores or simple tests on items similar to typical test items. No modification study has ever employed Orne's (1959) post experimental inquiry technique in an effort to determine the influence of demand characteristics. Perry (1977) noted that there may be no other possible way of performing such studies without telling subjects that increased hypnotic performance is what the experimenter hopes to obtain. This is what most investigators have done, and recent human subjects' legislation, at least in North America, serves further to complicate this necessary control.

The existence of numerous valid criticisms of modification studies does not mean that hypnotizability cannot be meaningfully modified. The present investigator was impressed by the significant increase in hypnotizability in a group of men, naive to the experimental foci, who underwent wintering-over isolation in Antarctica as reported in the previous chapter (Barabasz, 1979, 1980b). In another Antarctic isolation study (Barabasz & Gregson, 1978, 1979) men pre- and post- wintering-over were given a series of real and suggested odours while skin conductance response (SCR) and 8 channels of EEG data were collected. EEG evoked potential amplitude suppression, consequent upon stimulation, decreased for real odourants following wintering-over, but suppression consequent upon suggested stimulation increased. The increase in suggestibility and the shift in response to suggested stimuli seemed to indicate that the role of isolation is considerably more powerful than that required to modify responses to primary motoric items.

The purpose of the central investigation reported in the present chapter was to test the following hypotheses:

A) Hypnotizability will be significantly ($\alpha = .05$) enhanced for subjects exposed to laboratory controlled sensory deprivation immediately following the deprivation period. (Chapter I, p. 14).

B) These subjects will also demonstrate significantly ($\alpha = .05$) higher hypnotizability scores as contrasted with control subjects (Chapter I, Hypothesis #2, p.14).

C) In response to a post-hypnotic suggestion for glove analgesia, subjects exposed to laboratory controlled sensory deprivation will demonstrate significantly ($\alpha = .05$) increased pain threshold and tolerance scores as contrasted with their pre-deprivation scores, immediately following deprivation. These subjects will also demonstrate significantly higher ($\alpha = .05$) pain threshold and tolerance scores as contrasted with control subjects (Chapter I, Hypothesis #3, p.14).

An additional purpose was to test two sets of hypotheses conceptualized within the alternative theoretical orientations discussed in Chapter I (p. 7-13). The hypotheses tested are as follows:

A) On the bases of Reyher's (1964) theory, subjects exposed to laboratory controlled sensory deprivation will not differ significantly ($\alpha = .05$) in hypnotizability from their pre-deprivation scores or from control subjects 10-14 days after deprivation.

VERSUS

B) On the basis of the present investigator's reasoning conceptualized within J.R. Hilgard's (1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation will demonstrate significnatly ($\alpha = .05$) enhanced hypnotizability scores 10-14 days after deprivation as contrasted with their pre-deprivation scores and control subjects' follow-up scores.

C) On the basis of Reyher's (1964) theory subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia will not differ significantly in pain threshold and tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation.

VERSUS

D) On the basis of the present investigator's reasoning, conceptualized within E.R. Hilgard's neo-dissociation theory and J.R. Hilgard's (1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia will demonstrate increased pain threshold and tolerance scores as contrasted with their predeprivation scores and control subjects' scores 10-14 days after deprivation.

A secondary purpose was to examine skin conductance level (SCL) and EEG alpha density trends while controlling for core and peripheral subject temperatures. A previous study considering SCL failed to control for potential sweat gland/temperature interactions and measured only GSR (Sanders & Reyher, 1969) which has several disadvantages (e.g. non-linearity) as compared with direct measures of SCL (Barabasz, 1977b; Lykken & Venables, 1971). EEG alpha density, while popular in numerous studies of basal hypnotic susceptibility, has not been considered in the context of a modification study. It was hoped that the general instructions and the elaborateness of the measures for the secondary purpose would help to mask situational factors which might influence hypnotizability measures.

METHODOLOGY

Subjects

Subjects consisted of upper undergraduate and graduate level female volunteer (N = 20). Consistent with Sanders & Reyher (1968) subjects were all females. Hilgard (1979a) noted that no sex differences in average hypnotizability scores have been found between men and women in large samples of university students. However, item analysis (Hilgard, 1979a) showed a tendency for more women than men to have the experience of age regression within hypnosis. Subjects were paid $20 New Zealand for participation. At the time of recruitment, subjects were randomly divided into control ($\bar{X}$ age = 21 years 1 month; N=10) and experimental ($\bar{X}$ age = 21 years 5 months; N=10) groups within the constraints of scheduling. Control study subjects were given preliminary instructions favouring an increase in hypnotizability. Experimental study subjects were given details of the psychophysiological measures to be employed in the "Experiment on sensory deprivation." They were also told that some "short cognitive tests" such as memory for designs or hypnotizability would also be given to provide a student experimenter with practice. [1]

Major Apparatus and Experimental Setting

Two channels of EEG activity were recorded on the same San-Ei 1A61 electroencephalograph used in the Antarctic field study reported in the previous chapter. Using the International 10-20 system, Beckman silver/silver chloride biopotential hat electrodes with Beckman paste were placed at O_1 and O_2 fixed with colodian. A preliminary investigation using 5 undergraduate students not employed in the main experiment revealed the electrode fixing procedures developed for and used in Antarctica to be inadequate for long recording periods. The use of colodian, instead of bentonite paste, to seal the electrodes to the scalp, for the occipital placements, was found to be an effective solution to the problem.

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[1] A female Bachelors Degree (Hons.) student adminstered the hypnotizability tests to experimental and control groups to help mask the focus of the study. She was also essential in instrumenting the experimental subjects in the central investigation reported in the present chapter.

Left earlobe and neck earthing sites were fixed by double-sided adhesive washers. Channel 1 was monopolar (O_1 + earlobe reference). Channel 2 was bipolar (O_1 + O_2). Electrode scalp resistances were at or below 15k ohms and were monitored simultaneously for all sites on the San-Ei light emitting diode display. Raw bipolar EEG was also processed by a Lafayette/Cyborg 76771 Research EEG processor which provided a binary signal which was used to trigger a digital counter for signals within 8½ to 12½ Hz at a threshold of 18 μ volts. This was also the minimum useable threshold providing interrater reliabilities above .85 on the hand scored San-Ei analogue record in practice sessions.[1] Unlike digital (zero-crossing) filters, the filters used in this Cyborg processor will detect a low amplitude brain wave at one frequency in the presence of another brain wave of much higher amplitude. The filters 3dB points are one cycle on

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[1]See "Scoring" in the "Results" section. Interrater reliabilities were computed by rank order correlations using the 1 second period scores. The 18 μ volt threshold does not mean the rater's task was to discriminate pen amplitude deflections of this magnitude. As noted in the scoring section alpha was scored by frequency using a standard frequency template graduated in Hertz and not by pen deflection amplitude. In the normal adult EEG alpha (8-13 Hz) and beta (13-30 Hz) are the most common wave forms. Alpha commonly has magnitudes of 100 μ volts or more making scoring with a frequency templet a relatively simple task. The 18 μ volt threshold is noted because in the present study it was not possible to obtain reliable scores with deflections less than this amplitude (i.e. raters were not able to consistently align the frequency templet graduations with the sinus curve peaks when amplitudes were less than 18 μ volts).

each side of the center frequency selected. The filters roll-off at 20 dB per octave past the 3dB points. Thus, if the filter control is set at 10 Hz, a signal at 9 Hz would be attenuated by 23%. A signal at 7 Hz or 15 Hz would be attenuated by 75%.[1]

Skin conductance level (SCL) was monitored employing a Lafayette 76100-30 Barabasz Desensitization Quantifier (Barabasz, 1977a). Beckman silver/silver chloride biopotential hat electrodes were attached to the second and third digits of the left hand which was nondominant for all subjects (Lykken & Venables, 1971). Chamber ambient, subjects' core (rectal) and peripheral (1st digit volar surface left hand) temperatures were measured using a Biofeedback Technology BFT 302. The appropriate Yellow Springs 700 series probes were employed. Subjects' movement was monitored using a Lafayette 76100-30 equipped with a 76403 cardio-tach amplifier and 76605 piezoelectric crystal sensor. The crystal sensor was

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[1] Specifications and calibration: Frequency response-5to 15 Hz; Frequency bandpass-analog filter with 3dB points one cycle on each side of selectable center frequency; Roll-off-20 dB per octave; Frequency Accuracy- $\pm$.2 Hz; Input impedence - 200k ohms; Common mode rejection - greater than 80 dB (10,000:1); Threshold accuracy - .5%; Calibration voltage - 2 µV; Outputs - binary 0-5 V, TTL compatible, source 30 milliamps max; Power source - 8 std. 9 V. alkaline batteries, Dimensions - 533(w)x152.4(H)x304.8(D)mm, Weight-5.4Kg. (Note: this apparatus is also sold as the Cyborg BL541, one of the most widely used units at the time the study was conducted).

attached to subjects' right arm by velcro bands adjusted to a firm but reported as comfortable tension.

The sensory deprivation chamber was 2.6m long x 1.5m wide x 2.4m high and was sound attenuated. It was equipped with a bed, three overhead microphones, fluorescent lighting, video camera, electrically shielded junction boxes, silent positive pressure ventilation and a subject-accessible push button switch which activated a buzzer and light in the adjacent lab. The inter-communication and voice activated recording system was of local construction but followed Sanders and Reyher (1969). Deprivation subjects wore Ganzfeld goggles (Pollard, Uhr & Jackson, 1963). Unlike the dark conditions of Sanders and Reyher (1969) the present investigation employed a fully lighted deprivation chamber. The lighted conditions were used because: 1) an earlier study (Zubek & Welch, 1963) found greater EEG slowing using lighted perceptual deprivation conditions, 2) lighted conditions, combined with a closed circuit video system, were expected to assist in the application of the criteria designed to evaluate behavioural signs of sensory deprivation phenomena (see Appendix 3), and 3) assurance of subjects' physical safety was necessary (subjects were more heavily instrumented than in any previous sensory deprivation-hypnotizability study).

Procedure

Deprivation subjects were shown the monitoring equipment and were reminded of the psychophysiological focus of the "Experiment on sensory deprivation". They were also told that only one of the "practice cognitive tests" announced earlier would be used because of time constraints. Electrodes and transducers were attached in an established sequential progression while the experimenter provided social contact unrelated to the experiment. Subjects inserted their own rectal temperature probes but these were checked by the female research assistant. These probes are similar to those used by NASA, once inserted their presence is no longer detectable by the subject. Subjects wore cotton clothing without gloves.

Subjects reclined on the chamber bed and the Stanford Hypnotic Clinical Scale (SHCS) was administered (Morgan & J.R. Hilgard, 1975) by the female research assistant. (The present investigator was present during all administrations but this was not known by the subjects as monitoring was carried out in the adjacent lab.) The SHCS was chosen because (1) items such as age regression, dream. amnesia and posthypnotic suggestion are more difficult to experience than primary motoric items (Leva, 1974b); (2) it lends itself to bed reclined subjects; (3) it has demonstrated meaningful generalizability to hypnotic pain control; (4) it is reliable; and (5) it can be administered in a short period of time. Administration time was considered particularly important in the control of demand characteristics for the deprivation subjects. The SHCS was modified by addint an additional post hypnotic suggestion designed to create a glove analgesic reaction on the back of each subject's right hand.

A pain threshold and tolerance test was added to the post administration questioning employing a Lafayette 82450 shocker. The concentric electrodes were attached to the back of the subject's right hand with a velcro stretch band. Following the recommendations of Gregson (1978) and consistent with Wolff's (1980) findings, a simple direct scaling technique was employed.[1] Wolff's (1980) operational definition of pain threshold "as a given response pattern under given experimental conditions" was accepted for the present study. As was suggested (Wolff, 1980) no attempt to make inferences about it being related to an absolute sensory threshold was considered. Pain tolerance is operationally defined as "that point at which the individual will withdraw from or terminate noxious stimulation (Wolff, 1980). Consistent with Rollman (1979) "an ascending method of limits was used to obtain estimates of the threshold for pain and

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[1]Signal detection theory (SDT) techniques were not used to obtain the parameters of discrimination (d') (sensitivity) and criterion, because these techniques have not been found to be valid in the measurement of pain (McBurney, 1975, 1976; Rollman, 1976, 1977, 1979; Wolff, 1980). Rollman (1979) noted the SDT d' and criterion "do not measure pain." Wolff (1980) concluded "SDT is an inappropriate method for human algesimetry " instead simple "direct scaling techniques" were recommended.

tolerance." Starting with the zero setting on the shocker, shock levels were administered one graduation apart in ascending order with four trials per level (see also Appendix 9). Pain threshold was based on subjects' reports of "first detecting shock stimulation" (2 or more of the 4 trials at a specific setting). Pain tolerance was based on subjects' reports of the "intensity of stimulation detected as just below the maximum" they felt they could endure (see also Appendix 1, Preliminary Study #5). The submaximal endurance instruction was found to help minimize heroism as a measurement factor in pre-experimental testing with similar subjects not used in this study. Hilgard and Hilgard (1975) also avoided involvement with sensitivity and criterion measures in their book Hypnosis in the Relief of Pain, but concerns with "heroism" in pain tolerance measures were raised.

After the pain test the shocker electrodes were removed and subjects were asked to close their eyes for a 10 minute EEG recording period which was followed by doning of Ganzfeld goggles and earphones. Sanders and Reyher's (1969) instructions, less the hypnosis demand characteristics (see Appendix 2) were given over the earphones. Subjects were encouraged to describe their experiences over the intercommunication system but were told they would only receive three stock market quotes upon depressing the button provided. Low level white noise (Lafayette 15011) was then provided over the padded earphones. This served to prevent the subject from receiving auditory feedback from her body movements while only minimal feedback from vocalizations was possible. Subjects remained in sensory deprivation for 6 hours or until sensory deprivation signs were evident using the Sanders and Reyher (1969) criteria (see Appendix 3). Application of the criteria was aided by the closed circuit video system and the movement detection apparatus.

In addition to the pre-deprivation session baseline, EEG was also recorded for 1 minute at 15 minute intervals, for 10 minutes at 2 hours 10 minutes in deprivation (half the $\bar{X}$ of the Sanders & Reyher (1969) deprivation period) and for 10 minutes at the termination of deprivation. Skin conductance level (SCL) to the nearest μmho, chamber ambient, subject's core and peripheral temperatures were also recorded at 15 minute intervals. The SHCS and pain test was readministered at the end of the deprivation period and 10-14 days later. Previous research (Barabasz, 1980a) found that EEG alpha density and hypnotizability correlations could be enhanced by omitting portions of EEG record coincident with skin conductance response (SCR) measures of arousal, defined as SCR in excess of 50% of S's startle response. While it was not within the primary scope of the present experiment to further explore this earlier finding every attempt was made, subject to experimenters' primary data collection load, to manually note such arousal responses on the analogue EEG record at each data collection interval.

In consideration of plateau susceptibility (Shor, Orne & O'Connell, 1962) a control study was conducted to test for the effects of repeated hypnosis upon susceptibility and demand characteristics. Instructions favoured an increase in susceptibility. The procedures followed Sanders and Reyher (1969) except that a lounge setting rather than a cubicle was used. The SHCS and pain test were administered as for deprivation subjects.

Demand characteristics were evaluated by applying Orne's (1959) post experimental inquiry technique to all subjects.

RESULTS

Scoring

Alpha densities in the analogue EEG recordings were hand scored using a San-Ei precision frequency template. Using a band width of 8-13 Hz and a threshold of 18 μ volts, each one second period of record was considered separately. A score of one point was given if the majority of the one second period of record was within the above specification. Interrater reliability between two independent scorers was .95 for this period count method. Only bipolar EEG was used for analysis since there was data loss for three subjects on the monopolar channel due to detachment of the earlobe electrode. Processed EEG from the Lafayette/Cyborg 76771 was scored to the nearest tenth of a second continuously for each data collection period, as the binary output triggered an electronic digital counter. Skin conductance level (SCL) measures of arousal were recorded to the nearest μmho/sq./mm of electrode area. Temperature data was recorded in degrees Fahrenheit from the digital readout of the BFT 302. The SHCS was scored on the standardized 0-5 basis (Morgan & J.R. Hilgard, 1975). Means and standard deviations for Stanford Hypnotic Clinical Scale scores appear in Table 4.

TABLE 4

MEANS AND STANDARD DEVIATIONS FOR STANFORD HYPNOTIC CLINICAL SCALE SCORES

Group	Pre-Treatment		Post-Treatment		Follow-up	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Sensory deprivation	1.7	.82	4.2	.78	4.0	.66
Control	1.7	.82	1.6	.84	1.7	.94

Pain threshold and tolerance levels were scored in volts corrected across shock administration periods pre, post and follow-up by subjects' skin resistance converted mathematically from skin conductance levels. A particular subject's skin resistance can vary substantially (100k ohms to 1 meg ohm) within a short period of time. This means the identical scale setting on the shocker would result in administration of different voltage levels to a subject whose skin resistance had changed between measurement periods. Shocker scale values can only roughly approximate voltages administered to subjects unless these values are corrected on the basis of subjects' skin resistance.[1] For example, a scale setting on the shocker of "90" results in a subject voltage of 670 at a skin resistance of 100k ohms, the same setting gives a subject 860 volts when skin resistance is 500k ohms. Previous research (as noted in Hilgard & Hilgard, 1975) failed to consider subjects' skin resistance when, as in the present study, shock periods were administered hours and days apart. Shock voltage levels in this study were administered more precisely because shocker scale values for various voltages were set (corrected) in consideration of subject skin resistance levels according to pre-experimental calibration (See Appendix 9). Means and standard deviations for pain threshold and tolerance scores in volts appear in Table 5.

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[1]In the present study skin conductance was measured. Skin resistance is the mathematical reciprocal of conductance. These converted levels were used in conjunction with Table 11 (See Appendix 9).

TABLE 5

MEANS AND STANDARD DEVIATIONS FOR PAIN THRESHOLD AND TOLERANCE SCORES IN VOLTS

Pain Measure by Group	Pre-treatment		Post-treatment		Follow-up	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Deprivation Group						
Threshold	61.5	24.04	41.0	11.97	53.5	15.64
Tolerance	210.0	69.40	507.0	183.06	450.4	168.20
Control Group						
Threshold	64.5	23.8	60.4	22.03	62.0	25.01
Tolerance	217.0	72.42	198.0	67.96	203.5	71.03

Control Study

In order to test for the effects of repeated hypnosis (plateau effects) and the effects of demand characteristics upon SHCS susceptibility scores, threshold and tolerance pain levels, a multivariate analysis of variance (MANOVA) was completed. The MANOVA program from the University of North Carolina Thurstone Psychometric Laboratory was modified for local Burroughs B6718 use (Barabasz & Gregson, 1979). Control group pre, post and follow-up scores were used. An F of .155 ($p > .05$) was found showing no significant effects.

Main Hypotheses

In order to determine whether or not sensory deprivation affects SHCS susceptibility scores, threshold, or tolerance pain scores a multivariate analysis of variance (MANOVA) was computed. All effects were tested using Wilks Lambda. A one way MANOVA was computed on pre, post and follow-up scores. The result was significant ($F = 8.855$, $p < .001$, $R = .862$). Univariate F tests and correlations with the canonical variate (r_{ux}) appear in Table 6.

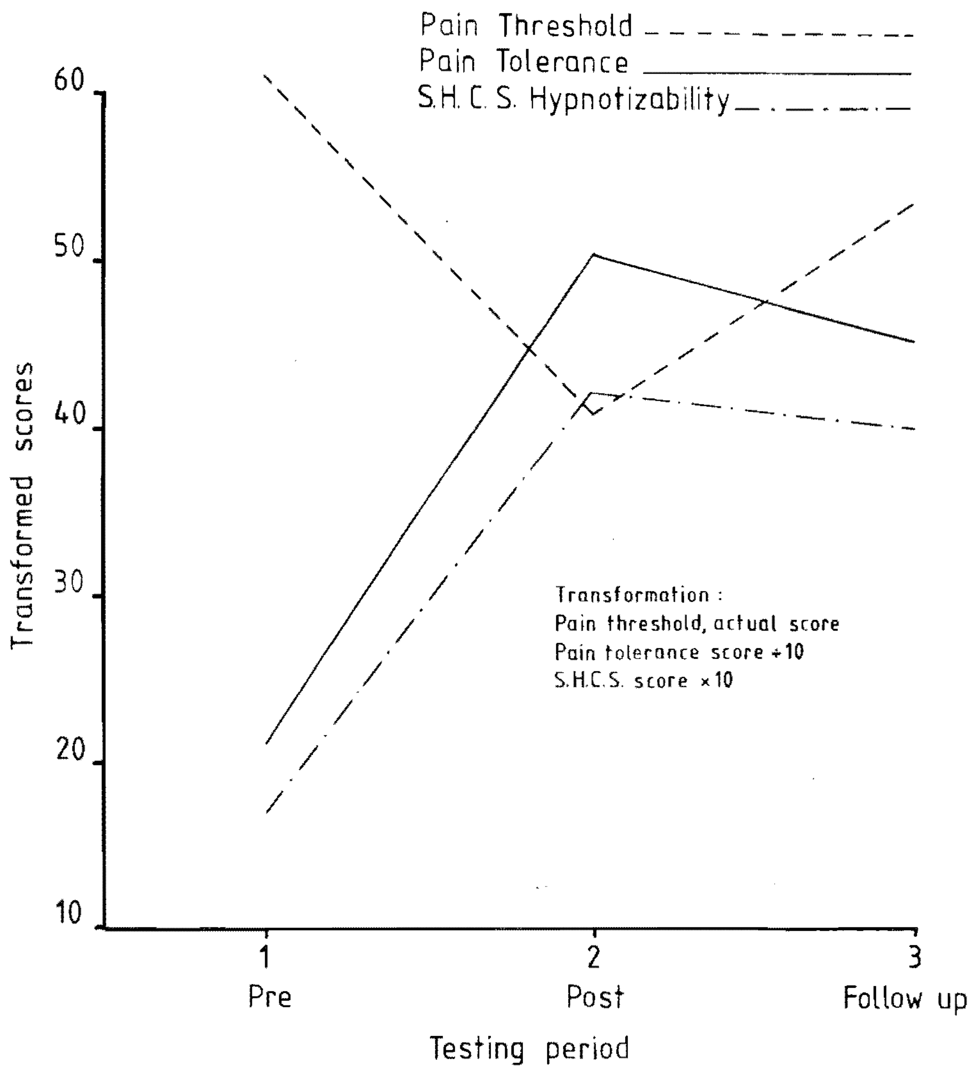
TABLE 6

SENSORY DEPRIVATION UNIVARIATE EFFECTS SUMMARY FOR STANFORD HYPNOTIC CLINICAL SCALE SCORES, PAIN THRESHOLD AND TOLERANCE LEVELS

Measure	F	$p <$	r_{ux}
SHCS Score	33.191	.001	- .921
Pain Tolerance	11.298	.001	- .538
Pain Threshold	3.315	.052	+ .254

The results presented in Table 6 demonstrate significant effects for sensory deprivation on SHCS hypnotizability, pain tolerance and pain threshold. The grouped results of the three measures, after transformation, appear in Figure 1.

FIGURE 1 TRANSFORMED COMPARISON OF S.H.C.S. HYPNOTIZABILITY SCORES PAIN THRESHOLD AND TOLERANCE LEVELS



Note : Only the shape of the curves may be meaningfully compared

Figure 1 shows that SHCS hypnotizability scores and pain tolerance increased after sensory deprivation and that these increases were maintained at the follow-up testing period. Pain threshold was reduced following deprivation but approached the pre-test level at the follow-up.

Since the MANOVA did not take into account repeated measures on the same subjects nor permit comparisons between the experimental and control groups t-tests were computed between control and experimental groups for post and follow-up SHCS hypnotizability scores. A t of 6.67 ($p < .001$) and 5.90 ($p < .001$) were found respectively showing extremely strong experimental effects. A t-test was also computed for pain tolerance for post and follow-up, t's of 4.98 ($p < .001$) and 4.06 ($p < .001$) were found respectively, again showing extremely strong experimental effects. Pain threshold scores were also subjected to t-test analysis for post and follow-up, t's of 2.32 ($p < .05$) and .87 ($p > .05$, not significant) were found respectively indicating a considerably weaker experimental effect at immediate post testing and no significant effect at follow-up.

Peripheral analyses - Psychophysiological Data

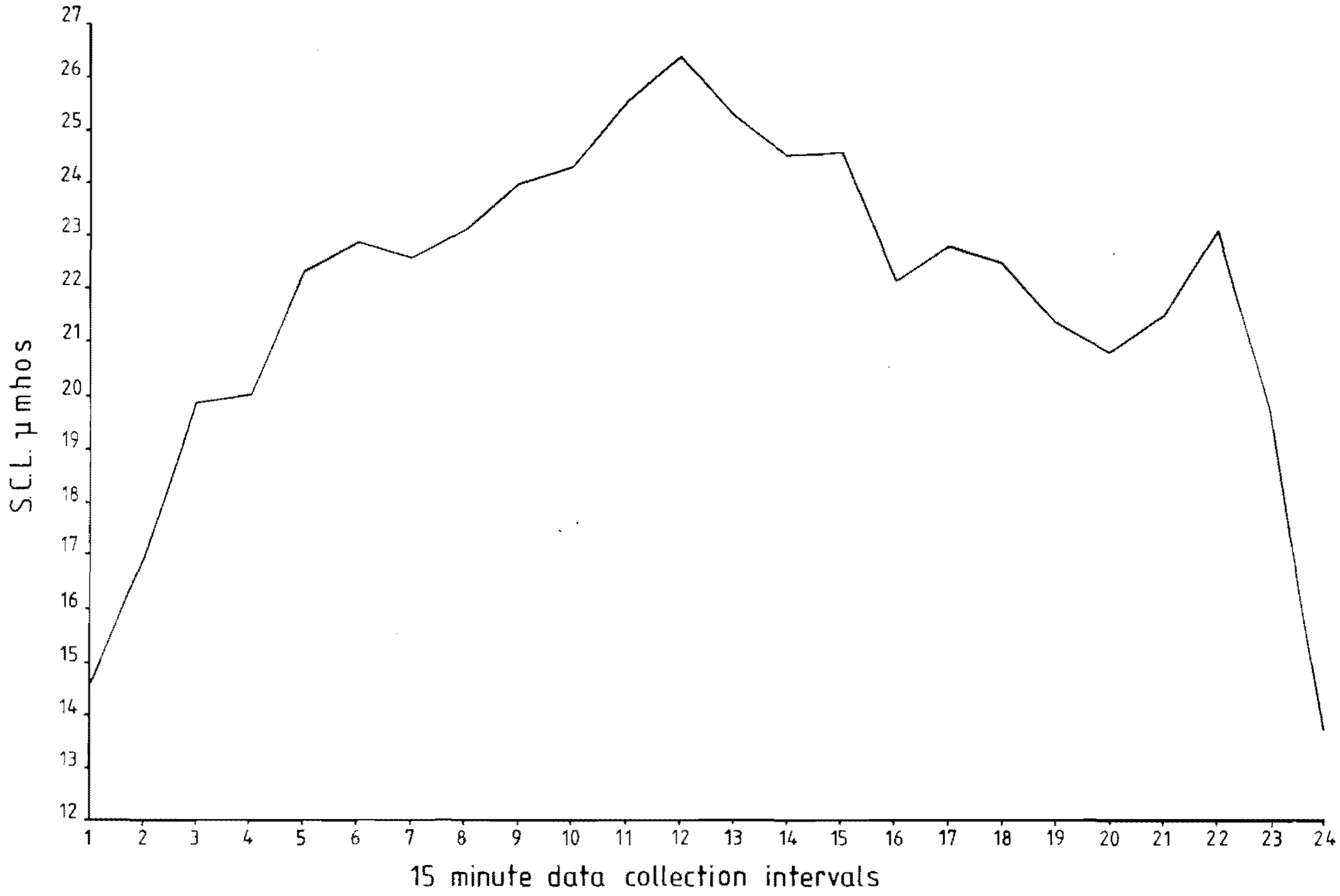
In order to test for sensory deprivation effects on psychophysiological responses a MANOVA was computed on hand scored EEG alpha, processed EEG alpha, skin conductance level (SCL), core, and peripheral temperature measures at five time levels equally spaced during the deprivation period. Since chamber temperature could only be held within a range of $3^{o}F$ this variable was also considered with the psychophysiological measures.

The subject (S) overall main effect was highly significant ($F = 63.503$, $p < .001$, $R = .988$) using Wilks Lambda. The time (T) main effect was also significant ($F = 15.158$, $p < .001$, $R = .950$). Only SCL, chamber temperature, hand scored EEG alpha, and peripheral temperature measures showed significant F tests (all $p < .001$) indicating significant differences occurred among the data collection observation periods in each measure.

In order to determine whether or not temperature variables accounted for hand scored EEG alpha and/or SCL a multivariate analysis of covariance was computed. The result failed to show a significant relationship between the two sets of variables ($\alpha = .05$, $R = .227$, $p < .824$). The small fluctuations in chamber ambient temperature ($3^{o}F$ range) did not appear to significantly influence peripheral temperature ($\bar{x}$ range = $9^{o}F$ per S). The correlation between peripheral temperature and chamber ambient temperature was not significant, ($\alpha = .05$, $r = .224$).

In order to further examine skin conductance levels in sensory deprivation the graphic method was employed. Mean skin conductance levels in µmhos are plotted for each of the 24 data collection intervals spaced 15 minutes apart over the six hour period. The results appear in Figure 2.

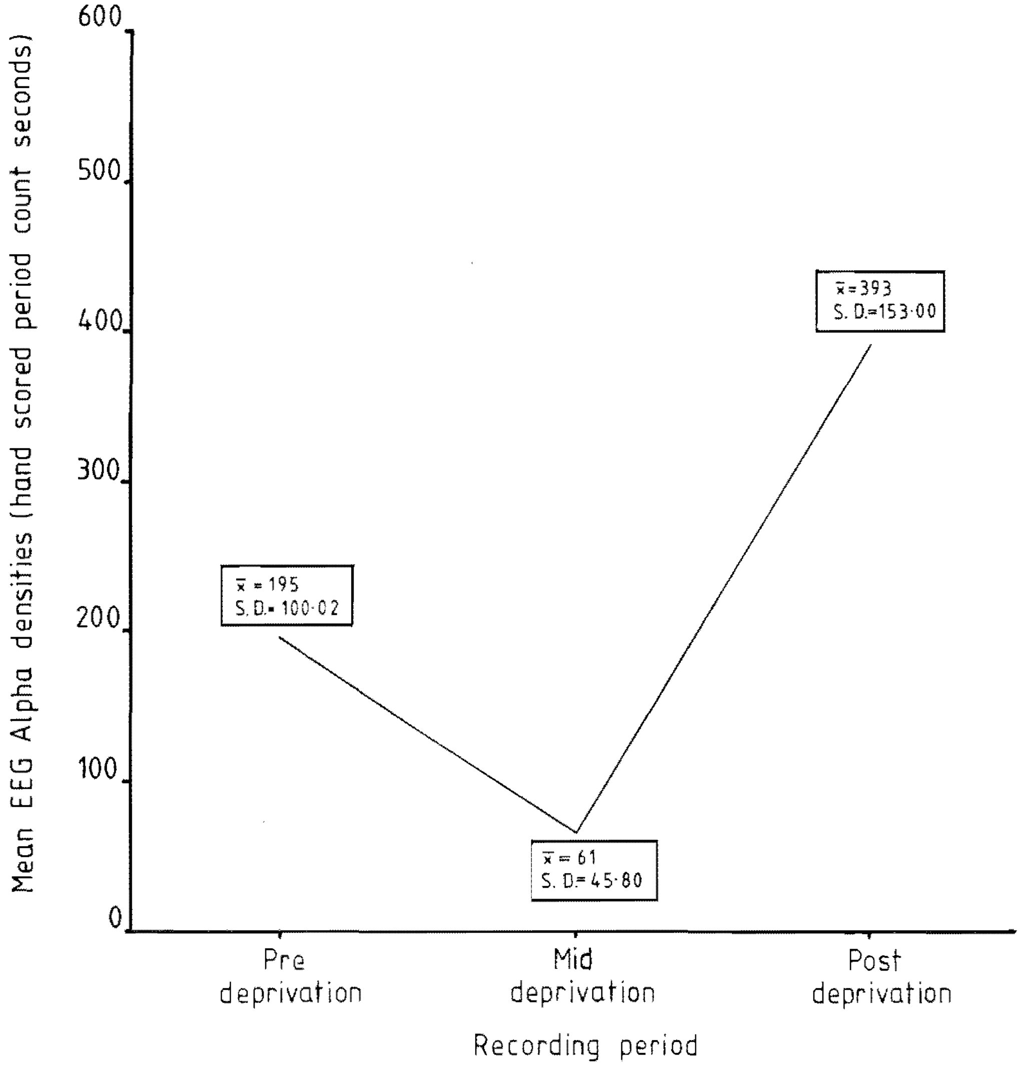
FIGURE 2 MEAN SKIN CONDUCTANCE LEVELS OVER 6 HOURS OF SENSORY DEPRIVATION



The graphic presentation of mean skin conductance levels over the 6 hour deprivation period, shown in Figure 2, reveals a marked increase in conductance over the first three hours followed by a decrease to below pre-deprivation levels of arousal.

In order to further examine hand scored occipital EEG alpha densities pre, mid and post sensory deprivation the graphic method was employed. Mean hand scored EEG alpha scores are plotted for the three major data collection points. The results appear in Figure 3.

FIGURE 3 OCCIPITAL EEG ALPHA DENSITIES PRE MID AND POST SENSORY DEPRIVATION FOR 10 MINUTE RECORDINGS



The graphic presentation of mean occipital EEG alpha densities shown in Figure 3 reveals a decrease from pre to mid deprivation followed by a marked increase shown at the post deprivation measure.

The three EEG alpha density levels were also analyzed using Wilcoxon Matched-Pairs Signed-Ranks tests. The non-parametric test was chosen for these final analyses because the less restrictive assumptions seemed more appropriate for data scored by the period count method used (Gregson, 1980). A significant decrease in alpha density occurred between pre and mid deprivation recordings (Wilcoxon $T = 1$, $N_s - R = 10$, $p < .01$). A significant increase in alpha density occurred between mid and post deprivation recordings (Wilcoxon $T = 0$, $N_s - R = 10$, $p < .01$). The pre vs post deprivation comparison was also significant (Wilcoxon $T = 7.5$, $N_s - R = 10$, $p < .05$) showing an increase in alpha density following sensory deprivation.

In order to determine whether or not EEG alpha densities were related to Stanford Hypnotic Clinical Scale (SHCS) hypnotizability scores rank-order correlations were calculated. The results appear in Table 7.

TABLE 7

RANK-ORDER CORRELATIONS FOR EEG ALPHA AND STANFORD HYPNOTIC CLINICAL SCALE (SHCS) HYPNOTIZABILITY SCORES INCLUDING SKIN CONDUCTANCE RESPONSE (SCR) CORRECTED PRE-DEPRIVATION RECORDS

SHCS measurement Period	EEG Alpha Recording Period		
	Pre-deprivation (SCR corrected)	Mid-deprivation	Post-deprivation
Pre-Deprivation	.52 (.65*)	.31	.47
Post-Deprivation	.32 (.39)	.20	.33

* $p < .05$

The results presented in Table 7 show a significant relationship between EEG alpha density and Stanford Hypnotic Clinical Scale (SHCS) scores for skin conductance response (SCR) in the corrected pre deprivation records only. No significant relationship was found between SHCS and EEG alpha density for any other measurement period.

Post Experimental Inquiry

Orne's (1959) post-experimental inquiry was conducted with experimental subjects to reveal demand characteristics which might have influenced hypnotizability, pain scores or other experimental effects. The inquiry was also conducted with control subjects. The primary aim of Orne's (1959) inquiry is to determine whether or not subjects were able to recognize the actual focus of the investigation. Subject responses were scored on a 0-2 basis. Subjects were scored 0 if there was no awareness of the studies' actual focus, 1 if there was suspicion of a focus outside of the announced focus, and 2 if the subject was able to identify the experimental focus in general or specific terms. The results of the inquiry appear in Table 8.

TABLE 8

POST-EXPERIMENTAL INQUIRY RESULTS

FOR EXPERIMENTAL AND CONTROL STUDY SUBJECTS

Subject No.	Experimentals	Controls
1	0	0
2	0	0
3	0	1
4	0	1
5	0	0
6	0	0
7	0	2
8	1	0
9	0	1
10	0	0

0 = No awareness of experimental focus

1 = Suspicious of possible focus outside of announced focus

2 = Identification of actual focus

The post-experimental inquiry results presented in Table 8 show that no experimental subject recognised the actual focus of the study. Only one experimental subject was even vaguely suspicious that the experiment might possibly involve foci in addition to that announced. Remarks made by the experimental subjects revealed the belief that the elaborate instrumentation used was confirmatory of the announced focus. The results presented in Table 8 also showed the majority of control subjects reflected their pre-experimental instructions. However, 3 subjects (scored 1) were suspicious that there was another major and unannounced focus of their participation and 1 subject (scored 2) identified her role as a control subject. This latter subject explained that she concluded she was a control between post and follow-up testing. Interestingly, the majority of controls felt they actually "did better" on the hypnosis test but only one subject improved her score by 1 point.

DISCUSSION

The major results of the study support the hypothesis that hypnotizability would be significantly enhanced for subjects exposed to laboratory controlled sensory deprivation immediately following the deprivation period (Hypothesis #2A, p.14). Indeed, some subjects who initially scored in the lower ranges became hypnotic virtuosos, attaining maximum Stanford Hypnotic Clinical Scale scores, following deprivation. (See Appendix for raw SHCS scores). These subjects also demonstrated significantly higher hypnotizability scores as contrasted with control subjects supporting the hypothesis (Hypothesis #2B, p.14).

In response to a post-hypnotic suggestion for glove analgesia subjects exposed to laboratory controlled sensory deprivation demonstrated significantly increased pain tolerance levels immediately following deprivation (Hypothesis #3A, p.14). However, the results failed to support the notion that pain threshold levels would also be significantly increased. Contrary to expectations, pain threshold levels decreased significantly following sensory deprivation. Perhaps of most importance is the finding that the enhancement of hypnotizability was significant and meaningful in its generalizability from the post hypnotic analgesia suggestion to the greatly increased pain tolerance levels which, as, discussed later, were also maintained at follow-up. The spontaneous lowering of pain threshold levels is difficult to explain since it would seem that a post hypnotic analgesia suggestion, successful in greatly raising pain tolerance, should also raise pain threshold levels. Vernon and McGill (1961) found significant increases in pain sensitivity, on electrical pain threhsold measures, as a result of sensory deprivation. However, if the general sensory deprivation effects accounted for the lower pain threshold they might also be expected to lower the tolerance levels. A more likely explanation became apparent upon review of the pain threshold instructions given to subjects combined with anecdotal information obtained in post experimental inquiries. Pain threshold levels were based on subjects' "reports of first detection of electrical shock stimulation". At the time, this was viewed by the present investigator and his colleagues as a pain threshold because of the "electrical shock stimulation" aspect. The subjects, however, viewed this as an instruction to report "the slightest sensation detectable" rather than a painful sensation. The subjects reported that they "felt something", or "felt the electrical trickle".

The results relating to the "conflicting hypnotizability" hypotheses are also of particular interest because of their theoretical implications. Subjects exposed to sensory deprivation demonstrated significantly enhanced hypnotizability scores 10-14 days after deprivation as contrasted with their pre-deprivation and control subjects' follow-up scores (Hypothesis #5B, p.15). Subjects exposed to sensory deprivation and a post hypnotic suggestion for glove analgesia demonstrated increased pain tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation (Hypothesis #7B, p.15). As in the post deprivation measures pain thresholds were lower than pre-deprivation levels, although scores at follow-up were less affected than immediately after deprivation.

Gardner and Licklider (1959) and Carlin, Ward, Gershorn, and

Ingraham (1962) reported that white noise has certain analgesic properties. The white noise used in the present study for masking potential noise in sensory deprivation, could conceivably have accounted for the increases in pain tolerance scores immediately after deprivation rather than effects due to increased response to the post hypnotic suggestion. The maintenance of enhanced hypnotizability and greatly increased pain tolerance levels at the follow-up testing, cannot, however, be accounted for by potential white noise effects.

The maintenance of significant follow-up enhancement effects in the absence of demand characteristics fails to support Reyher's (1964) theory as discussed in Chapter 1. Reyher (1964) reasoned that hypnosis and sensory deprivation are manifestations of the ascendance of lower levels of neural integration in the organization of brain functions and behavioural regulation. Adaptive behaviour was viewed as a function of high neuronal integration. Conditions which eliminate or homogenize sensory input prevent adaptive behaviour with adaptive neuronal integration replaced by a phylogenetically older and lower level of integration. Removal from sensory deprivation should then reactivate higher neuronal integration and adaptive behaviour. This would predict a return to pre-deprivation hypnotizability scores at the later follow-up. Indeed, Sanders and Reyher (1969) noted "This psychophysiological model *(Reyher, 1964)* suggests that S should not be removed from sensory deprivation prior to a hypnotic induction, as removal reactivates adaptive behaviour and its supporting level of neuronal integration."

The post-deprivation and follow-up enhancement effects seem consistent with E.R. Hilgard's (1977) neodissociation interpretation of hypnosis combined with J.R. Hilgard's (1974, 1979) imaginative involvement findings discussed in Chapter 1. It appears to the present author that sensory restriction forces the organism to focus, perhaps as seldom before, on internally generated imaginal activity. This defensive manouvre can be conceptualized as a dissociative reaction serving to maintain neural integration in the organization of brain functions.

Psychophysiological measures in the present investigation served the primary purpose of helping to mask situational factors which might otherwise have influenced hypnotizability and pain test results. The psychophysiological data collected in this context, however, helped to further support the investigation reported in Chapter III and to describe the effects of sensory deprivation.

Skin conductance measures involve sweat gland activity so the consideration of chamber temperature plus subjects' core and peripheral temperatures seemed important. The control of chamber temperature-range was not found to be critical since the $3^{o}F$

range of fluctuations did not significantly influence subjects' peripheral temperatures and changes in subjects' core temperatures were not significant. Zubek (1969, p.14) noted that during isolation "brain activity is progressively depressed" and "other indications such as skin conductance and body movements show increased arousal." As in the Antarctic investigation reported in Chapter III the present study showed a significant increase in EEG alpha densities from pre to post deprivation, but this slowing was not progressive as suggested by Zubek (1969). Mid-deprivation EEG alpha densities were significantly lower than either pre or post deprivation levels. This finding seems consistent with Nagatsuka and Kokubun's (1964) finding that although significant EEG slowing occurred such slowing was not progressive during deprivation.

The skin conductance results were also contrary to Zubek's (1969) report of increasing arousal in terms of average changes over the deprivation period. Skin conductance increased markedly from beginning to mid-deprivation then returned to pre deprivation levels by the end of the 6 hour deprivation period. Consistent with Zubek (1969), however, a few subjects began to show a marked increase in skin conductance just before removal from deprivation. The difference between the average end of deprivation skin conductance levels in the present study and the Zubek (1969) study might be accounted for by differences in the manner in which sensory deprivation was terminated. Zubek's (1969) subjects typically pushed themselves to the limit before removing themselves from deprivation resulting in deprivation periods of varying lengths. In such a situation electrodermal arousal could be expected to be high at the time deprivation was terminated. In the present study Sanders (1967) clinical criteria were applied (see Appendix) and subjects were removed from deprivation on this basis. While most of the subjects in the present study remained for the full 6 hour deprivation period it is interesting to note that in the few cases where subjects were removed early, on the basis of Sanders (1967) criteria, their records, consistent with Zubek (1969) reflected sharp increases in skin conductance which were orthogonal to their alpha densities (Orne, 1976). While selection of subjects for comparison in this manner and small N may only lead to speculation, it is of particular interest to note that these aroused subjects showed the lowest increases in hypnotizability scores while subjects showing the greatest decrease in skin conductance arousal and increase in alpha density showed the highest hypnotizability increases. These later subjects were the ones described earlier as hypnotic virtuosos. Their increases in hypnotizability did not correlate with the pre-deprivation scores. These speculations seem further substantiated when the concept is applied to previous research. Levitt, Brady, Ottinger and Hinesley (1962) found no increase in hypnotizability after deprivation. Their subjects were highly aroused at the end of deprivation. Subjects described themselves as "terrified". The most successful earlier hypnosis enhancement study reviewed (Sanders & Reyher, 1969) applied the Sanders (1967) criteria to remove subjects from deprivation as did the present study. Finally, moderate enhancement of hypnotizability was found by Pena (1963) whose subjects reported predominantly pleasant thought content while noting some stress.

The present study also further supported the use of the skin conductance response correction procedure to enhance EEG alpha density hypnotizability correlations in the hand scored records. Consistent with Stanford Lab experiences (MacDonald, 1980) the failure of the machine scored EEG alpha, a technique growing in popularity, to show significant trends demonstrated the necessity of collecting conventional analogue records to help control for artifacts.

The present investigation was the first hypnosis modification study to employ Orne's (1959) post experimental technique. The results of the inquiry supported the successful diverting of subjects' awareness as no experimental subject was able to identify the primary experimental focus. A simple three point scale was found to be helpful in evaluating the post experimental inquiry results.

Chapter V

BRIEF SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Principal foci of the thesis

On the basis of alternative theories in the literature it was hypothesized that hypnotizability could be meaningfully enhanced by sensory deprivation/restriction. The research also sought to test Reyher's (1964) psychophysiological theory of brain function in contrast to E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation interpretation of hypnosis combined with J.R. Hilgard's (1974, 1979) imaginative involvement findings. An attempt was made to control for a number of major factors not considered in earlier studies. An additional purpose was to determine the relationship between EEG alpha density and hypnotizability while controlling for electrodermal indices of arousal.

Summary of Principal Findings by Hypothesis

<u>General Hypnotizability Hypotheses</u>

1) Hypnotizability was found to be significantly enhanced for subjects exposed to the sensory/perceptual restriction of prolonged Antarctic isolation.

2) A. Hypnotizability was found to be significantly enhanced for subjects exposed to laboratory controlled sensory deprivation immediately following the deprivation period. B. These subjects also demonstrated significantly higher hypnotizability scores as contrasted with control subjects.

3) A. In response to a post-hypnotic suggestion for glove analgesia subjects exposed to laboratory controlled sensory deprivation demonstrated significantly increased pain tolerance scores as contrasted with their pre-deprivation scores, immediately following deprivation. B. These subjects also demonstrated significantly higher pain tolerance scores as contrasted with control subjects. The hypothesis that sensory deprivation subjects would demonstrate increased pain threshold levels immediately following deprivation and that these subjects would demonstrate significantly higher pain threshold levels as contrasted with control subjects was not supported by the data. Contrary to the prediction, pain tolerance levels showed a reduction after sensory

deprivation. This unexpected finding was, however, consistent with previous sensory deprivation research not involving analgesic post hypnotic suggestion and appeared to be accounted for by subjects' interpretation of the required self-report.

Hypnotizability Hypotheses Conceptualized within alternative theories

4) A. On the basis of Reyher's (1964) theory subjects exposed to laboratory controlled sensory deprivation were predicted not to show a significant change in hypnotizability from their pre-deprivation scores or from control subjects 10-14 days after deprivation. This hypothesis was not supported by the data.

VERSUS

5) B. On the basis of the present investigator's reasoning conceptualized within E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation theory and J.R. Hilgard's (1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation were predicted to demonstrate significantly enhanced hypnotizability scores 10-14 days after deprivation as contrasted with their pre-deprivation scores and control subjects' follow-up scores. This hypothesis was supported by the data.

6) A. On the basis of Reyher's (1964) theory, subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia were predicted not to differ significantly in pain threshold and tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation. The data did not support this hypothesis with respect to pain tolerance scores, the issue of greatest relevance to the contrast of theories and generalizability of changes in hypnotizability. The hypothesis was suported with respect to pain threshold, but this latter finding must be considered artifactual on the basis of subjects' interpretation of the required self report.

VERSUS

7) B. On the basis of the present investigator's reasoning, conceptualized within E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation theory and J.R. Hilgard's (1974, 1979) imaginative involvement findings, subjects exposed to laboratory controlled sensory deprivation and a post hypnotic suggestion for glove analgesia were predicted to demonstrate increased pain threshold and tolerance scores as contrasted with their pre-deprivation scores and control subjects' scores 10-14 days after deprivation. This hypothesis was supported by the data with respect to pain tolerance scores but not for pain threshold scores.

Conflicting Hypotheses Relating to EEG

8) On the basis of Dumas' (1977) findings drafted subjects naive with respect to the focus of the research were predicted not to demonstrate a significant EEG alpha density correlation with hypnotizability either prior to or following the sensory/perceptual restriction of prolonged Antarctic isolation. The data appear to support the hypothesis with respect to pre Antarctic isolation, however, following isolation the correlation showed a tendency ($.05 < p < .10$) toward significance.

VERSUS

9) On the basis of Engstrom's (1976) findings drafted subjects naive with respect to the focus of the experiment were predicted to demonstrate a significant EEG alpha density correlation with hypnotizability prior to and following the sensory/perceptual restriction of prolonged Antarctic isolation. The data do not appear to suport this hypothesis with respect to pre Antarctic isolation, however, following the isolation the correlation showed a tendency ($.05 < p < .10$) toward significance.

Hypothesis Relating to Skin Conductance Arousal

10) On the basis of Crosson's (1977) view it was hypothesized

that Dumas' (1977) consistent findings of no correlation between alpha density and hypnotizability for drafted naive subjects can be accounted for by suppression of subjects' typical eyes-closed alpha due to arousal. Specifically, drafted subjects naive with respect to the focus of the experiment will demonstrate enhanced EEG alpha density and hypnotizability correlations prior to and following Antarctic isolation when portions of EEG records coincident with skin conductance measures of arousal are omitted from the computation of EEG alpha density. This hypothesis was supported by the data, thereby it also supports Engstrom (1976) as predicted in hypothesis #9.

Summary of Additional Findings of Interest

Findings of preliminary and technical investigations are noted in the relevant chapters and in the Appendix. The additional findings of major interest only are briefly summarized here.

1. In testing Hypothesis #10 a new method of evaluating EEG records was developed and found to be of utility. Omitting portions of waking eyes-closed EEG records coincident with skin conductance response indices of arousal was found to significantly enhance EEG alpha-hypnotizability correlations in both the Antarctic naive subject field investigation and in the volunteer subject laboratory controlled sensory deprivation investigation.

2. Consistent with the general EEG-Sensory/perceptual deprivation/ restriction literature EEG alpha densities increased significantly following Antarctic isolation and following laboratory controlled sensory deprivation. Contrary to Zubek's (1969) review, but consistent with Nagatsuka and Kokubun (1964), the EEG slowing was not progressive during sensory deprivation. Mid deprivation EEG alpha densities were significantly lower than either pre- or post-deprivation levels.

3. Average skin conductance levels increased markedly from pre- to mid-deprivation then returned to pre-deprivation levels by the end of the 6 hour deprivation period. This finding was also contrary to Zubek's (1969) emphasis on increasing arousal throughout deprivation but might be accounted for, at least in part, by differing methods of releasing subjects from deprivation. Consistent with Zubek (1969), a few subjects showed marked increased just before release from deprivation.

4. Speculative findings based on inspection of the data for laboratory controlled sensory deprivation subjects appeared to indicate that subjects showing skin conductance arousal immediately prior to release from deprivation showed the lowest gains in hypnotizability while subjects showing the greatest decrease in arousal and increase in EEG alpha

densities became hypnotic virtuosos with maximum post deprivation hypnotizability scores.

5. Orne's (1959) post experimental inquiry did not reveal demand characteristics in the laboratory controlled deprivation experiment that might have accounted for the hypnotizability or pain test findings.

Brief Summary of Major Conclusions

The major results of this thesis support the hypothesis that hypnotizability can be significantly enhanced by sensory/perceptual deprivation/restriction. Significant and marked increases in hypnotizability were found following Antarctic isolation and laboratory controlled sensory deprivation. The increases in hypnotizability were more than mere changes on standardized tests. The enhancement effects generalized to marked increases in pain tolerance levels in response to a post-hypnotic suggestion for glove analgesia. The durability of these findings was supported by general maintenance of enhanced hypnotizability as well as pain tolerance responses at the 10-14 day follow-up. Experimental effects appeared extremely strong when results were compared with a control group. Plateau susceptibility changes did not appear to account for experimental effects since the control group showed no significant changes in hypnotizability or pain scores over repeated administrations of hypnosis. The application of Orne's (1959) post experimental inquiry technique suggested that demand characteristics did not account for experimental findings.

Recommendations for further research

The research presented establishes the utility of sensory deprivation in the enhancement of hypnotizability while supporting E.R. Hilgard's (1976, 1977, 1979b) neo-dissociation theory and J.R. Hilgard's (1974, 1978) imaginative involvement findings as a possible theoretical basis for the phenomena. It appears that a number of areas requiring further research are now opened. Perhaps the most exciting would be to focus on maximizing responsiveness to hypnosis by determining ideal times to remove subjects from deprivation on an individualized basis. Research in this area is suggested by the observation that subjects who became hypnotic virtuosos, scoring the maximum on the hypnotizability scale following deprivation, were those that showed the greatest decrease in electrodermal measures of arousal combined with the greatest increased in EEG alpha density. To study this area thoroughly it would be necessary to conduct a series of sensory deprivation hypnotizability studies over several years in which subjects are removed from sensory deprivation while showing alternative psycho-physiological response trends. Skin conductance level trends could be expected to be reliably obvious during data collection but adequate real time or nearly real time evaluations of EEG alpha density levels will most likely require a micro-computer interface. In view of the equivocal findings of the machine scored alpha in the present study it would seem that considerable effort will be required to establish the reliability of on-line EEG analysis. Hypnotizability measures in future deprivation studies, might also benefit from the use of the Stanford Hypnotic Susceptibility Scale Form C if its administration length (1hr 15min average) can be masked from creating demand characteristics. The Form C taps hypnotic responsiveness more widely than does the Stanford Clincial Scale, and so it may provide further data on specific effects of sensory deprivation in the enhancement of hypnotizability.

Future research in sensory deprivation-hypnotizability might also benefit from an alternative pain measure. In the present research "pain threshold" levels were of little value, as Hilgard and Hilgard (1975, p. 38) noted, "the problem facing the person suffering from pain is not how little he can detect; rather, it is how to cope with enduring pains well above threshold." The present research applied careful controls in the use of concentric electrode electrical stimulation including score calibration based on subjects' skin conductances, and a reporting method (based on preliminary investigation) which minimized heroism in subjects' reports for pain tolerance measures. Pain threshold data was, however, of little value. Future pain measures of hypnotic generalizability following sensory deprivation might employ cold pressor or ischemic pain (Hilgard & Hilgard, 1975, p. 39 & 41). Both methods provide continuous subject report data rather than a maximal or submaximal level.

Additional technical research is needed on the use of skin conductance correction procedures in the enhancement of EEG alpha density-hypnotizability correlations. Subjects' electrodermal associative reaction times vary, so this aspect should be considered more extensively in future work of this type. Experimenter overload can easily cause data loss in the manual activation of event marking on EEG records, with a subsequent loss of the enhancement value of the correction procedure. One simple method employing a Schmitt trigger could be used in an attempt to solve this problem. After determining the 50% point of the subjects' skin conductance startle response in the manner described in Chapter III, the Schmitt trigger could be used to detect the time at which the skin conductance recording pen crosses this 50% level. When this level is crossed a set of contacts could be triggered, the output of which could be used to automatically activate the event marker on the EEG recorder.

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Appendix 1

Abstracts of preliminary, and technical studies related to the central investigations

Study #1 Since many studies of hypnotizability employ university students as subjects a preliminary investigation was conducted to compare the hypnotic susceptibility of the Scott Base subjects (Chapter III) with that of university students. Scott Base subjects' pre-winter hypnotizability scores, on the modified Barber scale items described in Chapter III were compared with a group of 34 students enrolled at the University of Canterbury. A Wilcoxon Contrast for two independent samples (Mann-Whitney U) was calculated. The calculation yielded a Z of 2.02 ($p < .05$). Prior to wintering-over the Scott base group was found to be significantly lower in hypnotizability than the university student group.

Study #2 Electrode type/placement combinations used in Antarctica (Chapter III) were developed on the basis of a preliminary technical experiment. Inmate volunteers (N = 8) were tested at Paparua Prison, Christchurch, New Zealand. Wire ring scalp electrodes, of local construction, as used at Sunnyside Hospital, Christchurch, were found to provide the best EEG analogue records and best attachment convenience for scalp sites when tested against grass gold cup electrodes, and San-Ei silver/silver chloride electrodes. Beckman silver/silver chloride biopotential hat electrodes with Beckman paste and double sided adhesive washer attachment were found to provide the best EEG analogue records and attachment convenience for frontal, earlobe and earthing placement sites. The very limited Antarctic working space was also simulated at Paparua prison to provide experimenter practice.

Study #3 The modified Barber Suggestibility Scale items (Barber & Glass, 1962) used in the Chapter III Antarctic study and the Stanford Hypnotic Clinical Scale (Morgan & J.R. Hilgard, 1975) were administered to 34 upper level students enrolled at the University of Canterbury, New Zealand. A rank order correlation between the measures was significant ($r = .37$, $p < .05$) showing a relatedness between the two measures. Broad. (1979) also found a significant correlation ($r = .42$, $p < .05$) between the two measures using an N of 20.

Study #4 A preliminary technical investigation was conducted to determine the adequacy of the Antarctic study EEG electrode attachment techniques for the longer (6 hour) period required in the laboratory controlled sensory deprivation investigation. Five undergraduate students not employed in the main experiment served as subjects. Subject resistance levels in ohms were monitored on the light emitting diode display of the San-Ei 1A61 electroencephalograph. The procedures developed for and used in Antarctica were found to be inadequate for long recording periods due to drying of the bentonite contact medium used in scalp placements. Such drying increased measured resistance exceeding 100 k ohms in periods exceeding 1½ hours. The use of colodian to seal silver/silver chloride hat electrodes to the scalp was found to be an effective solution to the problem. Resistance levels could be maintained at or below 15 k ohms for periods exceeding 6 hours.

Study #5 The electric shock pain tolerance test used in the Chapter IV laboratory study was pre-tested using 9 university community subjects not involved in any other experiment. A Lafayette 82450 human subjects shocker was employed. The concentric electrodes were attached to the back of subjects' hands with a velcro stretch band. A variety of instructions were tried in attempts to elicit accurate pain tolerance subject self reports. Testing sessions were followed by informal inquiries which stressed honesty reporting. A submaximal endurance instruction was found to help minimize heroism as a measurement factor. It was decided to instruct subjects (in the Chapter IV central investigation) to report when they felt the intensity of stimulation detected was "just below the maximum" they could endure.

Appendix 2

Instructions to Subjects Chapter IV Research

The central investigation reported in Chapter IV sought to eliminate the instructional demand characteristics present in the investigation by Sanders and Reyher (1969). The instructions used in the Chapter IV investigation and those used by Sanders and Reyher (1969) are reported below.

Instructions (From Sanders and Reyher, 1969)

Underlined sections were considered by the present investigator to constitute significant demand characteristics which might have encouraged S to provide the data Sanders and Reyher (1969) hoped to obtain.

> Prior to S's entry into the deprivation cubicle, she was told that the session was designed to test the effect of sensory deprivation on her ability to be hypnotized. She was specifically instructed as follows:
>
> Please tell me whatever you can about your reactions to this session. Your experiences while in sensory deprivation and subsequently those you have while being hypnotized will be helpful in understanding the results of the study. Whatever you choose to talk about will, of course, be kept strictly confidential. Also, try not to sleep during the session, but if you should doze off, don't feel guilty about it. At no time

will I respond to what you say or answer any questions you may ask, or communicate with you in any way, unless you depress the switch on the bed. If you depress the switch, I shall read three stock market quotations to you. However, I shall always be in the adjacent room listening to what you say. I shall begin the hypnotic induction over the earphones at some point during the next 6 hours. After you are hypnotized, I shall enter the room to continue with some tasks similar to those we did the last time. Do you have any questions?

Instructions (As employed in the Chapter IV investigation)

Prior to S's entry into the deprivation cubicle, she was repeatedly told that this was an "Experiment on sensory deprivation" with the aim of obtaining psychophysiological data. She was also initially told that some short "cognitive tests" such as memory for designs or hypnotizability would also be given to provide the student experimenter with practice. Just prior to commencing the experimental session S's were told that only one of the "practice cognitive tests" announced earlier would be used because of time constraints.

Please tell me whatever you can about your experiences in sensory deprivation. This information will be helpful in understanding the results of the study. Whatever you choose to talk about will, of course, be kept strictly confidential. Also, try not to sleep during the session, but if you should doze off, don't feel guilty about it. At no time will I respond to what you say or answer any questions you may ask, or communicate with you in any way, unless you depress the button on the bed. If you depress the button, I shall read three stock market quotations to you. However, I shall always be in the adjacent room listening to what you say. After the deprivation period I shall enter the room to continue with some tasks similar to those we did the last time. Do you have any questions?

Appendix 3

Sanders (1967) Criteria for Classifying Sensory Deprivation Phenomena

I. Craving for stimulation

Evidence:

a. Receiving stock market quotations or preoccupation with the stock market button.

b. Statements indicating the wish for something to do or something to see.

c. Self stimulation including singing, counting, tactile stimulation, etc.

d. Bodily preoccupation.

e. Asking E direct questions or demanding E to respond to S.

f. Statements of wanting to be hypnotized or to hear E's voice as a signal the experiment is over or wanting to quit.

g. Boredom and preoccupation with the passage of time.

II. Emotional lability

Evidence:

a. Evidence of restlessness, fear, anxiety, or anger.

b. Crying, weeping, or statements of depression.

c. Marked fluctuation in mood.

d. Somatic disturbance.

e. Feelings of isolation and impending doom.

III. Impaired secondary process and reality testing

Evidence:

a. Marked impairment of the logical content in thought and speech.

b. Spontaneous hypnogogic states characterized as waking dreams.

c. Hallucinatory experiences, somatic delusions, bodily disorientation.

d. Personalistic interpretations.

e. Preoccupation with fantasy or vivid unusual imagery.

f. Blank periods indicating inability to concentrate.

IV. Intensification of the relationship between *E* and *S*

Evidence:

a. Statement of *S*'s feelings about *E*.

b. Statements of personal problems and conflicts to *E*.

c. Personal questions from *S* to *E*.

d. Speculation about *E*.

e. Statements indicating need for contact with *E*.

Appendix 4

Raw Scores

TABLE 9

RAW STANFORD HYPNOTIC CLINICAL SCALE SCORES FOR LABORATORY CONTROLLED SENSORY DEPRIVATION SUBJECTS

Pre-Deprivation	Post-Deprivation	Follow-up
2	5	5
2	5	4
1	4	4
2	4	4
0	3	3
3	4	4
2	3	4
1	4	3
2	5	4
2	5	5
$\bar{X}$ = 1.7	$\bar{X}$ = 4.2	$\bar{X}$ = 4.0

TABLE 10

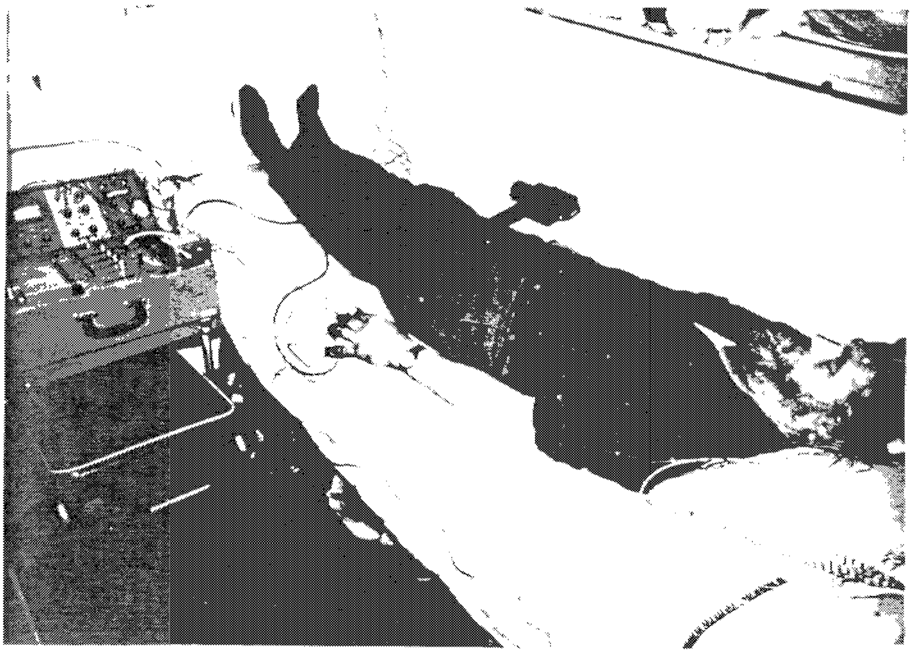
RAW STANFORD HYPNOTIC CLINICAL SCALE SCORES

FOR CONTROL STUDY SUBJECTS

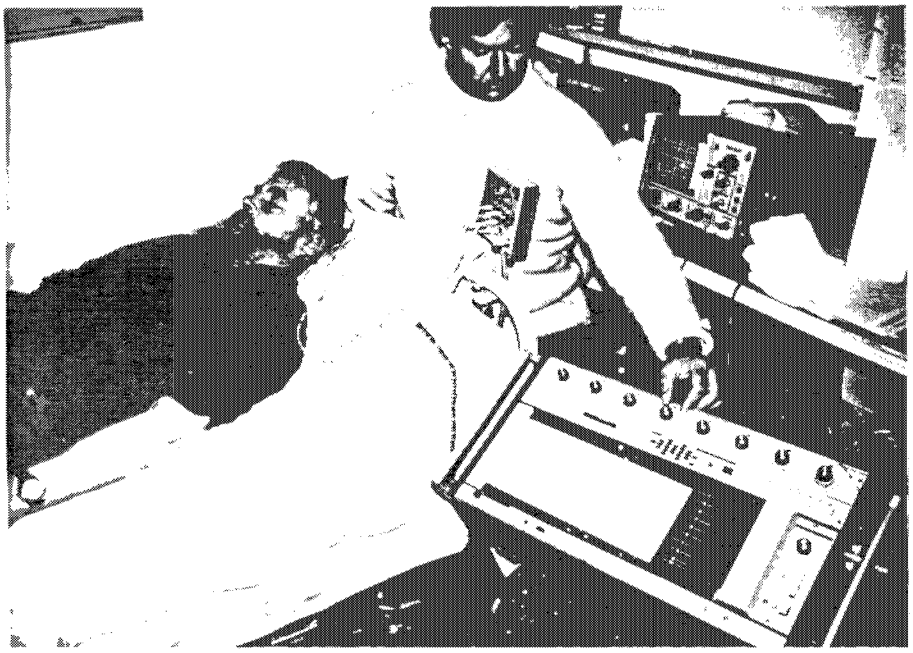
Pre-Placebo Condition	Post-Placebo Condition	Follow-up
2	2	2
1	1	1
2	1	2
1	2	2
1	1	1
3	3	3
2	2	3
1	0	0
1	2	1
3	2	2
$\bar{X}$ = 1.7	$\bar{X}$ = 1.6	$\bar{X}$ = 1.7

Appendix 5

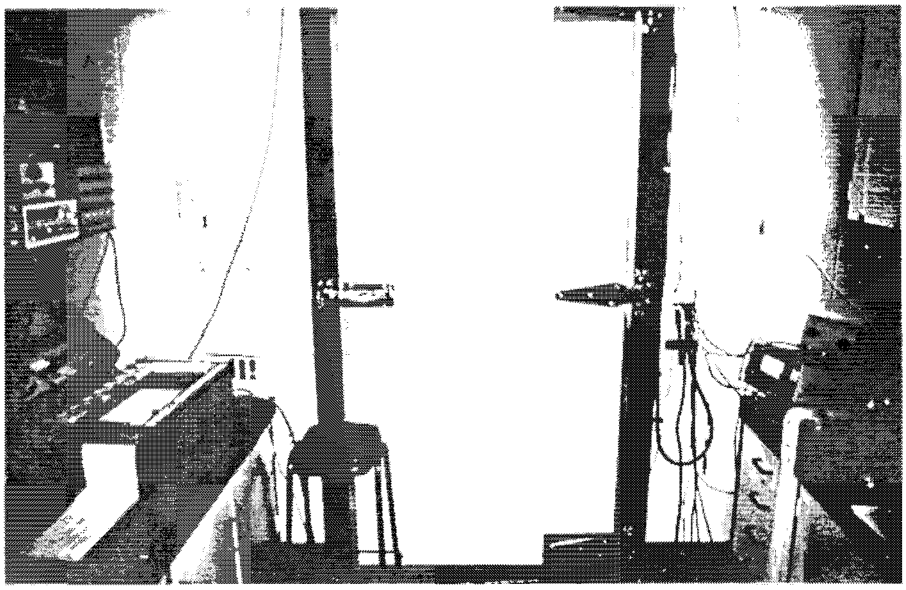
Laboratory Photographs



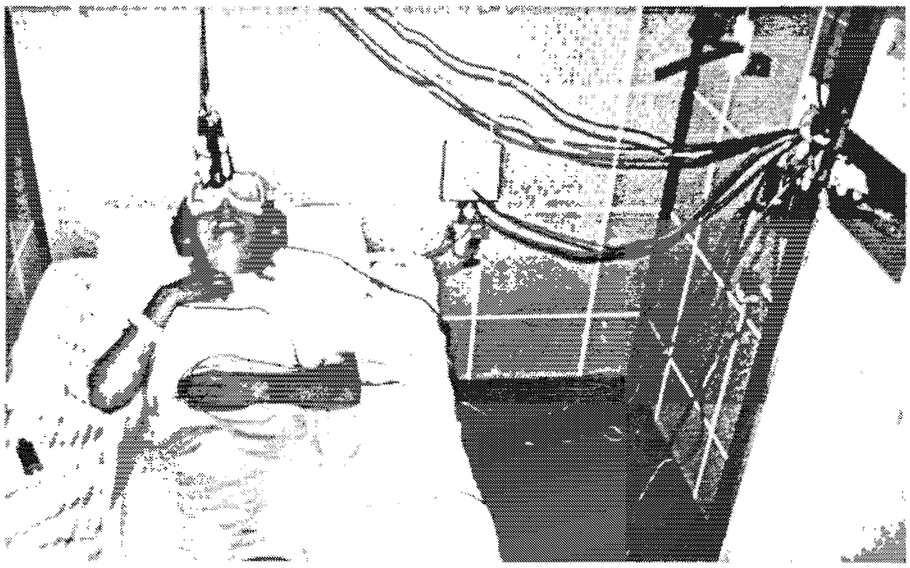
Scott Base Antarctica lab showing Skin Conductance datagraph and wintering-over officer-in-charge. (see Chapter III)



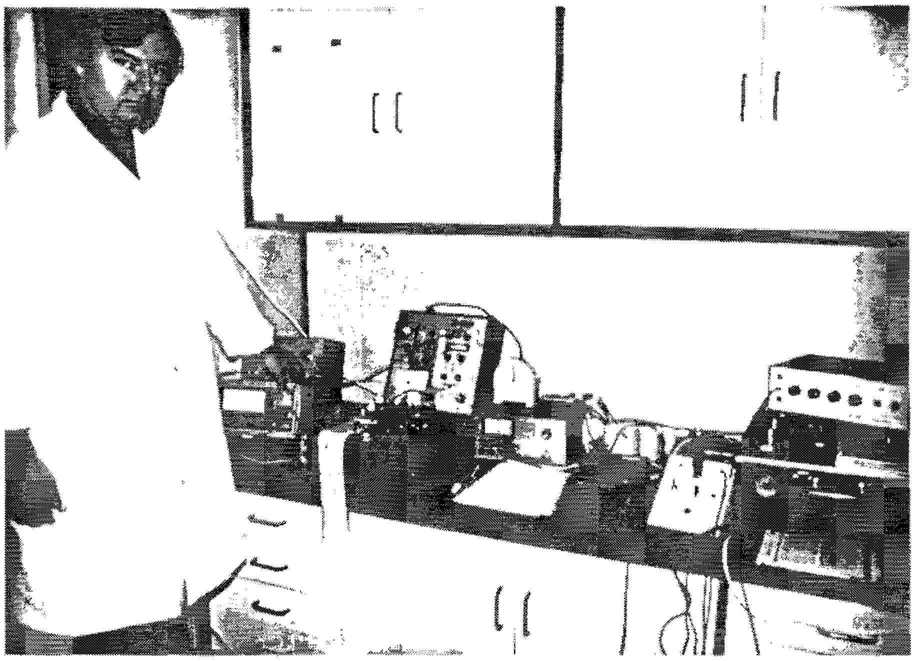
Scott Base Antarctica lab showing San-Ei Electroencephalograph operated by Dr A.F. Barabasz. (see Chapter III)



Outer lab showing sensory deprivation chamber entrance/exit outer door and psychophysiological monitoring equipment. Subject push button activated lamps used to obtain stock market quotes are mounted at eye level left and right of doorway. (See Chapter IV)



Sensory deprivation chamber showing a fully instrumented subject, overhead microphones, shielded electrode junction boxes, and subject stockmarket push button (lower left). (See Chapter IV)



Outer lab showing Dr A. F. Barabasz, (left to right) voice activated relay atop temperature monitor, movement detection apparatus atop skin conductance datagraph, timer atop white noise generator, tape recorder and intercommunications system. (See Chapter IV)

Outer lab showing Ms Kerry-Anne Abelson assisting Dr A. F. Barabasz with EEG electrode placement on subject. Left shows San-Ei electroencephalograph, Cyborg EEG processor, electronic timer and peripheral equipment. (See Chapter IV)

Appendix 6

Barber Suggestibility Scale

Instructions to S - "The better you can imagine and the harder you try, the more you'll respond. Try as hard as you can to concentrate, and to imagine the things I tell you." (Barber & Glass, 1962).

EIGHT TEST-SUGGESTIONS

1. *Arm Lowering.* "Hold your right arm straight out in front of you like this." (Guide the subject to extend the right arm directly in front of body at shoulder height and parallel to the floor.) "Concentrate on your arm and listen to me."

(Begin timing) "Imagine that your right arm is feeling heavier and heavier, and that it's moving down and down. It's becoming heavier and heavier and moving down and down. It weighs a ton! It's getting heavier and heavier. It's moving down and down, more and more, coming down and down, more and more; it's heavier and heavier, coming down and down, more and more, more and more." (End 30 seconds)

"You can relax your arm now." (If necessary, ask the subject to lower the right arm.)

Objective score criterion: 1 point for response of 4 inches or more. (Response is measured by placing a ruler near the subject's hand at the beginning of the suggestions and noting degree of displacement at the end of the second suggestion period.)

2. *Arm Levitation.* " Keep your eyes closed and put your left arm straight out in front of you in the same way. Concentrate on your arm and listen to me."

(Begin timing) "Imagine that the arm is becoming lighter and lighter, that it's moving up and up. It feels as if it doesn't have any weight at all, and it's moving up and up, more and more. It's as light as a feather, it's weightless and rising in the air. It's lighter and lighter, rising and lifting more and more. It's lighter and lighter and moving up and up. It doesn't have any weight at all and it's moving up and up, more and more. It's lighter and lighter , moving up and up, more and more, higher and higher." (End 30 seconds)

"You can relax your arm now." (If necessary, ask the subject to lower his arm.)

Objective score criterion: 1 point for response of 4 inches or more during 30-second suggestion period.

3. *Hand Lock.* "(Keep your eyes closed.) Clasp your hands together tightly, and interlace the fingers." (If necessary, the experimenter states, "Press your hands together, with palms touching," and assists the subject to interlock the fingers and to bring the palms together.) "Put them in your lap. Concentrate on your hands and hold them together as tightly as you can." (Begin timing) "Imagine that your hands are two pieces of steel that are welded together so that it's impossible to get them

apart. They're stuck, they're welded, they're clamped. When I ask you to pull your hands apart they'll be stuck and they won't come apart no matter how hard you try. They're stuck together; they're two pieces of steel welded together. You feel as if your fingers were clamped in a vise. Your hands are hard, solid, rigid! The harder you try to pull them apart the more they will stick together! It's impossible to pull your hands apart!. The more you try the more difficult it will become. Try; you can't." (End 45 seconds)

(5-second pause) "Try harder; you can't." (10-second pause) "You can unclasp your hands now."

Objective score criteria: ½ point for incomplete separation of the hands after 5-second effort; 1 point for incomplete separation after 15-second effort.

4. *Thirst "Hallucination"* ("Keep your eyes closed.") (Begin timing) "Imagine that you've just finished a long, long walk in the hot sun. You've been in the hot sun for hours, and for all that time you haven't had a drink of water. You've never been so thirsty in your life. You feel thirstier and thirstier. Your mouth is parched, your lips are dry, your throat is dry. You have to keep swallowing and swallowing. You need to moisten your lips. (3-second pause) You feel thirstier and thirstier, drier and drier. Thirstier and thirstier, dry and thirsty. You're very, very thirsty! Dry and thirsty! Dry and thirsty!" (End 45 seconds) "Now,imagine drinking a cool,

refreshing glass of water."(5-second pause)

Objective score criteria: ½ point if the subject shows swallowing, moistening of lips, or marked mouth movements; additional ½ point if the subject indicates during the "post-experimental" questioning that he became thirsty during this test (e.g. "I felt dry," "I was parched," "I felt somewhat thirsty"). (See "post-experimental" questions for final scoring criteria on this test.)

5. *Verbal Inhibition.* "Keep your eyes closed." (Begin timing) "Imagine that the muscles in your throat and jaw are solid, and rigid, as if they're made of steel. They're so solid and so rigid, that you can't speak. Every muscle in your throat and mouth is so tight and so rigid that you can't say your name. The harder you try to say your name the harder it becomes! You can't talk! Your larynx has tightened up; your throat and jaw feel as if they are in a vise. Your throat is clamped so tightly that you can't talk; you can't say your name. The harder you try the harder it will be. It's useless; the words won't come out; you can't speak your name; it's impossible to talk! The harder you try to say your name the harder it will become. Try; you can't." (End 45 seconds)

(5 second pause) "Try harder; you can't." (10 second pause) "You can say your name now."

Objective score criteria: ½ point if the subject does not say his name after 5-second effort; 1 point if he does not say his name after 15 second effort.

6. *Body Immobility.* ("Keep your eyes closed.") (Begin timing) "Imagine that for years and years you've been sitting in that chair just as you are now. Imagine that you've been sitting in that chair

so long that you're stuck to it! It's as if you're part of the chair. Your whole body is heavy, rigid, solid and you weigh a ton. You're so heavy that you can't budge yourself. It's impossible for you to stand up, you're stuck right there! Your body has become part of the chair. When I ask you to stand up you won't be able to do it! You're stuck tight. The harder you try the tighter you'll be stuck and you won't be able to get up. You're heavy in the chair! Stuck in the chair; you can't stand up. You're so heavy and stuck so tight. You can't stand up; you're stuck. Try; you can't." (End 45 seconds)

(5 second pause) "Try harder; you can't." (10 second pause) "You can relax (or sit down) now."

(The subject is considered *not* standing if he rises slightly from the chair without straightening into an erect posture. In this event, the experiemnter says, "Try to stand fully erect; you can't," instead of "Try harder; you can't.")

Objective score criteria: ½ point if the subject is not standing fully erect after 5-second effort; 1 point if not standing fully erect after 15-second effort.

7. *"Posthypnotic-Like" Response*. (The auditory stimulus consists of tapping once on the metal back of a stop watch with a fountain pen.) (Begin timing) "When this experiment is over in a few minutes and your eyes are open, I'll click like this (experimenter presents auditory stimulus) and you'll cough automatically. At the moment I click (experimenter presents stimulus) you'll cough. It will happen automatically. When I click like this (stimulus is presented)

you'll cough immediately; I'll click and you'll cough. When your eyes are open I'll click (stimulus is presented) and you'll cough. When I click you'll cough."(End 30 seconds)

Objective score criterion: 1 point if the subject coughs or clears his throat "post-experimentally" when presented with the auditory stimulus.

8. *Selective Amnesia*. "Your eyes are still closed but I'm going to ask you to open them in a minute. When they're open I'm going to ask you to tell me about these tests." (Begin timing) "You'll remember all the tests and be able to tell me about them, all except for one. There's one that you'll completely forget about as if it never happened! That's the one where I said your arm was becoming lighter and moving up and up. You'll forget all about that and when you try to think about it, it will slip even further away from your mind. You will forget completely that I told you that your arm was becoming lighter. This is the one test that you cannot remember! You will remember that I said your arm was heavy and all the other tests will be perfectly clear but the harder you try to remember that I told you your arm was rising the more difficult to remember it will become. You will not remember until I give you permission by saying, 'Now you can remember,' and then, and only then, you will remember that I said your arm was rising!" (End 45 seconds)

Objective score criterion: 1 point if the subject does not refer to the Arm Levitation item (Test-Suggestion 2) but recalls at least four other items and then recalls Test-Suggestion 2 in response to the cue words.

"POST-EXPERIMENTAL" OBJECTIVE SCORING OF TEST-SUGGESTIONS 4, 7, AND 8

"(Open your eyes,) the experiment is over."

Scoring of Test-suggestion 7. The "Posthypnotic-Like" Response item (item 7) is scored at this point. The experimenter presents the auditory stimulus after the subject has opened his eyes and before conversation commences.

Scoring of Test-Suggestion 8. The experimenter next asks: "How many of the tests can you remember?"

The experimenter prompts the subject by asking, "Were there any others?" "Can you think of any more?", and "Is that all?", until the subject mentions at least four of the test-suggestions. If the subject verbalizes the Arm Levitation item during his recital, he receives a score of zero on Test-Suggestion 8 (Selective Amnesia). If the subject does not include the Arm Levitation item in his enumeration, the experimenter finally states, "Now you can remember," and, if the subject still does not verbalize the Arm Levitation item, "You can remember perfectly well now!"

The subject receives a score of 1 point on Test-Suggestion 8 (Selective Amnesia) if he mentions at least four of the test-suggestions, but does not mention the Arm Levitation item before he is given the cue words, and verbalizes the Arm Levitation item when given the cue words, "Now you can remember," or "You can remember perfectly well now!"

Final Scoring of Test-Suggestion 4. The Objective scoring of Test-Suggestion 4 is completed when the subject refers to this item during his recital. At this point the experimenter asks: "Did you become thirsty during this test?" If the subject answers Yes to this question he receives the additional ½ point on item 4. If the subject answers Yes but adds a qualifying statement, e.g., he had been thirsty to begin with, he is asked: "Did the imaginary glass of water help quench your thirst?" If the subject now answers Yes he receives the additional ½ point.

The maximum Objective score obtainable on the BSS is 8 points.

SUBJECTIVE SCORES

Immediately after the Objective scores have been assigned, the experimenter mentions each test-suggestion that the subject has passed with an Objective score of either ½ or 1 point and asks the subject if he felt the suggested effect or if he went along with the suggestion to follow instructions or to please the experimenter. Specifically, the following questions are asked (with respect to those test-suggestions that the subject has passed with an Objective score of either ½ or 1 point.)

1. "When I said that your right arm was heavy and was coming down, did your arm feel heavy or did you just let it come down in order to follow instructions or to please me?"

2. "When I said that your left arm felt light and was rising, did your arm feel light or did you raise it deliberately in order to

follow instructions or to please me?"

3. "When I said that your hands were stuck and you couldn't take them apart, did you actually feel that you couldn't take your hands apart or did you keep your hands together in order to follow instructions or to please me?"

4. "When I said that you were becoming very thirsty, did you actually become very thirsty or did you just act as if you were thirsty in order to follow instructions or to please me?"

5. "When I said that you couldn't say your name, did you actually feel that you couldn't speak your name or did you just go along with the suggestion in order to follow instructions or to please me?"

6. "When I said that you were stuck in the chair, did you feel that you were stuck and unable to stand up or did you just go along with the suggestion to follow instructions or to please me?"

7. "When I clicked and you coughed, did you feel that you coughed automatically or did you cough deliberately in order to follow instructions or to please me?"

8. "Did you actually forget that I had said that your arm was rising or did you just act as if you had forgotten in order to follow instructions or to please me?"

A Subjective score of 1 point is assigned for each test-suggestion passed objectively which the subject testifies that he had "felt". The maximum Subjective score obtainable is 8 points.

Scoring Blank for BSS

Subject's name ______________________________ : Sex ______ : Age ___ :

Date _____________ : Experimenter's name __________________________

Experimental procedure ____

	Objective Score	Subjective Score
1. Arm Lowering. Arm down: inches ________	_____	_____
2. Arm Levitation. Arm up: inches ________	_____	_____
3. Hand Lock; Hands opened before 5 secs. ______;	_____	_____
hands opened after 5 secs. ______;	_____	_____
hands not opened after 15 secs. ______;	_____	_____
4. Thirst "Hallucination". Swallowed ______; moved mouth ______;	_____	_____
licked lips ______; felt thirsty ______;	_____	_____
5. Verbal Inhibition. Said name before 5 secs. ______;	_____	_____
said name after 5 secs. ______;	_____	_____
did not say name after 15 secs. ______;	_____	_____
6. Body Immobility. Got up before 5 secs. _______;	_____	_____
got up after 5 secs. _______;	_____	_____
did not stand up after 15 secs. _______;	_____	_____
7. "Posthypnotic-Like" Response. Did cough ______; didn't cough ______;	_____	_____
8. Selective Amnesia. Remembered amnesia task _______;	_____	_____
didn't remember until given permission__.	_____	_____
Total Score	_____	_____

Appendix 7

THE STANFORD HYPNOTIC CLINICAL SCALE (SHCS)

The SHCS (Morgan & J.R. Hilgard, 1975) is a "later adaptation" (Hilgard, 1979a) of the Stanford scales using items from the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C) (Weitzenhoffer & Hilgard, 1962). The Stanford scales and an adaptation known as the Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1962) are the most widely used instruments in hypnosis research. The scales have been translated into a number of languages. The scales, based on over 20 years of extensive and exacting research by Ernest R. Hilgard and his associates at the Stanford Laboratory of Hypnosis Research have been used in over 1000 research investigations. In comparison with other existing scales Hilgard (1979a) concluded that the Stanford scales "hold up very well against the others." These highly refined standardized scales are no more subject to experimenter bias than are I.Q. tests. As in the case with I.Q. tests, test retest reliabilities for the Stanford scales commonly are in the "high 80's and 90's (Hilgard, 1965). As Orne (1979) has pointed out, the problem in hypnosis research is not experimenter bias but rather the experimental demand characteristics placed upon the subject.

Concurrent validity studies of the SHCS used in the present study have been conducted (Hilgard & Hilgard, 1975). The product moment correlation between SHCS total score and the SHSS:C total score was .72. The corresponding correlation between the four items common to both the SHCS and the SHSS:C was .81 (Hilgard & Hilgard, 1975). Means for males and females on the SHCS were not significantly different.

This investigator has personally administered the SHCS on at least 400 occasions and has taught the use of the scale to a large number of psychologists and psychiatrists. Reliable scoring has never been found to be a problem. The scoring criteria for item number 1 might appear vague. In practice, however, it is quite straightforward in virtually all cases tested by this investigator. Ss hands either move slowly together until touching each other or hands remain well spread apart (about 12 inches). In the present study only one subject out of the total N of 20 failed to pass the item in pre-testing. In post tests this subject's hands touched each other. As noted in the Procedure section of Phase II Investigations, this investigator observed all SHCS administrations. Test results were independently scored by the female E and this investigator. Interrater agreement was 100%.

Protocol for Administering the Stanford Hypnotic Clinical Scale (SHCS)
(Morgan & J.R. Hilgard, 1975)

(Patient may be seated in any kind of chair with arms, or may be in bed, sitting or lying.)

Introductory Remarks

In a moment I shall hypnotize you and suggest to you a number of experiences which you may or may not have, and a number of effects which you may or may not produce. Not everyone can have the same experiences or produce the same effects when hypnotized. People vary greatly. We need to know which experiences you can have so we can build on them and know how to make hypnosis best serve you. Please remember always to respond to what you are *feeling*, so we can use hypnosis in ways that are natural for you.

Induction

Please close your eyes and listen carefully to what I say. As we go on, you will find yourself becoming more and more relaxed.... Begin to let your whole body relax....Let all the muscles go limp.... Now you will be able to feel special muscle groups relaxing even more. If you pay attention to your right foot, you can feel the muscles in it relax...feel the muscles in the right lower leg relaxing...in the right upper leg relaxing....Now on the left side, concentrate on the way that the left foot is relaxing... and the left leg, how the lower part and the upper part are both relaxing more....Next, you'll be able to feel the muscles of the right hand relaxing, the right lower arm and the right upper arm relaxing...Now direct your attention to your left hand. Let it relax, let the lower arm and the upper arm relax....As you have become relaxed, your body begins to feel rather heavy. Just think of the chair (bed) as being strong, sink into it, and let it hold you....Your shoulders...neck...and head, more and more relaxed....The muscles of your scalp and forehead, just let them relax even more....All of this time you have been settling more deeply and more comfortably into the chair (bed).

Your mind has relaxed, too, along with your body. It is possible to set all worries aside. Your mind is calm and peaceful. You are getting more and more comfortable....You will continue to feel pleasantly relaxed as you continue to listen to my voice...Just keep your thoughts on what I am saying...more and more deeply relaxed and perhaps drowsy but at no time will you have any trouble hearing me. You will continue in this state of great relaxation until I suggest that it is time for you to become more alert.... Soon I will begin to count from one to twenty. As I count, you will feel yourself going down further and further into this deeply relaxed hypnotic state. You will be able to do all sorts of things that I suggest, things that will be interesting and acceptable to you. You will be able to do them without breaking the pattern of complete relaxation that is gradually coming over you....one - you are becoming more deeply relaxed...two - down, down into a deeper, tranquil state of mind...three - four - more and more relaxed...five - six - seven - you are sinking deeper and deeper. Nothing will disturb you. You are finding it easy just to listen to things that I say...eight - nine - ten - halfway there...always deeply relaxed...eleven - twelve - thirteen - fourteen - fifteen - although deeply relaxed, you can hear me clearly. You will always hear me distinctly no matter how hypnotized you are...sixteen - seventeen - eighteen - deeply relaxed. Nothing will disturb you...nineteen - twenty - *completely relaxed.*

You can change your position any time you wish. Just be sure you remain comfortable and relaxed.

You are very relaxed and pleasantly hypnotized. While you remain comfortable listening to my words, I am going to help you learn more about how thinking about something affects what you do. Just experience whatever you can. Pay close attention to what I tell you, and think about the things I suggest. Then let happen whatever you find is happening, even if it surprises you a little. Just *let it happen by itself.*

1. *Moving hands together (or, if one arm is immobile, go to 1a, Hand lowering)*

All right, then...please hold both hands straight out in front of you, palms facing inward, hands about a foot apart. Here, I'll help you. *(Take hold of hands and position them about a foot apart.)* Now I want you to imagine a force attracting your hands toward each other, pulling them together. Do it any way that seems best to you - think of rubber bands stretched from wrist to wrist, pulling your hands together, or imagine magnets held in each hand pulling them together - the closer they get the stronger the pull....As you think of this force pulling your hands together, they will move together, slowly at first, but they will move closer together, closer and closer together as though a force is acting on them...moving ...moving...closer, closer....

(Allow ten seconds without further suggestion, and note extent of motion.)

That's fine. Everything is back to normal now. Just place your hands in their resting position and relax.

(Score + if hands move slowly toward each other, and are not much more than six inches apart at the end of ten seconds.)

(If no preference, use fourth grade.) (New Zealand = Standard 3)

All right then, I would like you now to think about when you were in the (*selected*) grade of school, and in a little while, you are going to *feel* as if you are growing younger and smaller, going back to the time you were in the (*selected*) grade....*one*, you are going back into the past. It is no longer (*state present year*), nor (*state an earlier year*), nor (*state a still earlier year*), but much earlier...*two*, you are becoming much younger and smaller...in a moment you will be back in the (*selected*) grade, on a very nice day. *Three*, getting younger and younger, smaller and smaller all the time. Soon you will be back in the (*selected*) grade, and you will feel an experience exactly as you did once before on a nice day when you were in school. *Four*, very soon you will be there....Once again a little boy (girl) in the (*selected*) grade. Soon you will be right back there. *Five!* You are now a small boy(girl) in school.... Where are you?....What are you doing?....Who is your teacher?.... How old are you?....What are you wearing?.... Who is with you?....

(Ask additional questions as appropriate. Record answers.)

That's fine....Now you can grow up again. You are no longer in the (*selected*) grade but getting older, growing up. You are now your correct age, this is (*current day and date*), and you are in (*locale of testing*). You are no longer a little boy (girl), 1a. *Hand lowering* (alternative to *Moving hands together*)

(If one hand is immobile for any reason, we recommend substituting a hand lowering suggestion, similar to that given as Item 1 in SHSS:C. The arm is held straight out at shoulder height, with the palm of the hand up. The suggestion is given to imagine something heavy in the hand pressing it down. After a few suggestions of downward movement, if the arm is not completely down, a 10-second wait is introduced. The item is passed if the hand has lowered at least six inches by the end of the 10 seconds.)

2. *Dream*

Now I am going to ask you to keep on relaxing, and this time you are going to have a dream...a real dream...much like the kind you have when you sleep at night. When I stop talking to you very shortly, you will begin to dream. Any kind of dream may come....Now it is as though you are falling asleep, deeper and deeper asleep. You can sleep and dream about anything you want to. As soon as I stop talking, you will begin to dream. When I speak to you again in a minute or so, you will stop dreaming if you are still dreaming, and you will listen to me just as you have been doing. If you stop dreaming before I speak to you again, you will remain pleasantly and deeply hypnotized. Now just sleep and have a dream.

(Allow 1 minute. Then say:)

The dream is over, but you can remember it well and clearly, very clearly....I want you now to tell me about your dream, while remaining deeply hypnotized. Please tell me about your dream...right from the beginning. Tell me all about it. *(Record verbatim.)*

(If subject has no dream:) That's all right. Not everyone dreams.

(If subject hesitates or reports vaguely, probe for details.)

Inquiry: How real would you say your dream was?

Termination: That's all for the dream. Remain as deeply hypnotized as you have been.

(Score + if subject has an experience comparable to a dream... not just vague fleeting experiences or just feelings or thoughts. The dream should show imagery, some reality, and not give evidence of being under voluntary control.)

3. *Age regression*

Something very interesting is about to happen. In a little while you are going back to a happy day in elementary school. If you had a choice to return to the third, fourth, or fifth grade, would you prefer one of these to the other?

(If yes:) Which grade?

but an adult, sitting in a chair (bed) deeply hypnotized. How old are you?....And what is today? Where are you?...Fine. Today is (*correct date*) and you are (*correct age*) and this is (*name place where subject is being tested*). Everything is back as it was. Just continue to be comfortably relaxed....

(Postpone scoring until inquiry at end.)

4. *Posthypnotic suggestion (clearing throat or cough);*
5. *Amnesia*

Stay completely relaxed, but listen carefully to what I tell you next. In a little while I shall begin counting backwards from ten to one. You will gradually come out of hypnosis, but you will be the way you are now for most of the count. When I reach "five" you will open your eyes, but you will not be fully awake. When I get to "one" you will be entirely roused, as awake as you usually are. You will have been so relaxed, however, that you will have trouble recalling the things I have said to you and the things you did. It will take so much effort to think of these that you will prefer not to try. It will be much easier just to forget everything until I tell you that you can remember. You will forget all that has happened until I say to you: "Now you can remember everything!" You will not remember anything until then. After you wake up you will feel refreshed. I shall now count backwards from ten, and at "five", not sooner, you will open your eyes but not be fully aroused until I reach "one".

At "one" you will be fully awake. A little later I shall tap my pencil on the table like this. (*Demonstrate with two taps*). When I do, you will feel a sudden urge to clear your throat or to cough. And then you will clear your throat or cough. You will find yourself doing this but *you will forget that I told you to do so*, just as you will forget the other things, until I tell you, "Now you can remember everything." All right, ready - ten - nine - eight - seven - six - five - four - three - two - one. (*If subject has eyes open*) How do you feel? Do you feel alert? (*If groggy:*) The feeling will go away soon. You feel alert now!

(*If subject keeps eyes closed:*) Please open your eyes. How do you feel?
(*If groggy:*) You are beginning to feel more alert and refreshed.... You feel alert now!

(Hypnotist now taps pencil against table twice. Wait ten seconds.)

(Score + if patient clears throat or coughs after pencil tap.)

Now I want to ask you a few questions about your experience. Please tell me in your own words everything that has happened since I asked you to close your eyes.

(*Record subject's responses verbatim. If blocked, ask, "Anything else?" and record answers until subject reaches a further* *impasse.)*

Listen carefully to my words. *Now you can remember everything.* Anything else now?

(Again record subject's responses verbatim. Remind subject of any items not recovered; note these also.)

(Score + if subject recalls no more than two items before memory is restored.)

(If subject is awake and comfortable:) That's all now. You are completely out of hypnosis, feeling alert and refreshed. Any tendency that you may have to clear your throat or to cough is now completely gone.

FOR CORRECTING DIFFICULTIES WHEN NECESSARY:
(If there is residual difficulty, e.g., difficulty in restoring alertness or persistence of a cough, proceed as follows with appropriate suggestions.) Please close your eyes and drift back into hypnosis as I count to five. One - two - three - four - five....Now I am about to arouse you by counting backwards from five to one. You will feel alert, refreshed, with no tendency to cough. (*Wait ten seconds*.) Five - four - three - two - one. Fully aroused!

Scoring Blanks for SHCS

ITEM	SCORE
1. MOVING HANDS TOGETHER (or 1a. HAND LOWERING) Describe movement: (At end of session, probe for type of experience if movement is very fast:) Score (+) if movement is slow and hands are not more than six inches apart by end of 10 seconds.	(1)___
2. DREAM Record dream, or report thoughts, fanatasies, etc.: Score (+) if subject has an experience comparable to dream, not just vague fleeting experiences or just feelings or thoughts. The dream should show imagery, some reality, and not give evidence of being under voluntary control.	(2)___

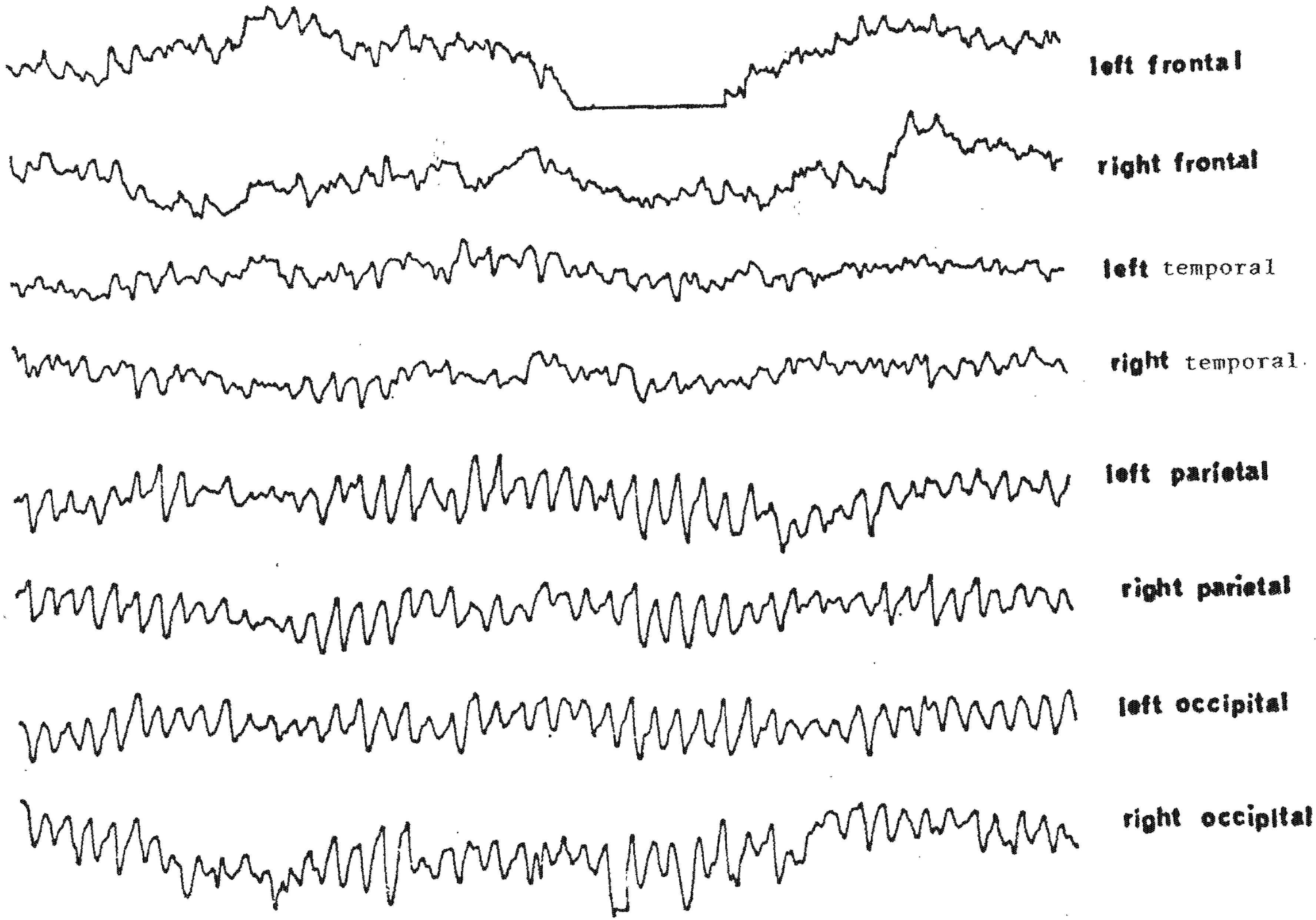
ITEM	SCORE
3. AGE REGRESSION (SCHOOL) Selected grade: ____________ Where are you? ______________________ What are you doing? ______________________ ______________________ Who is your teacher? ______________________ How old are you? ______________________ What are you wearing? ______________________ Who is with you? ______________________ a. Hypnotist's rating: __________ : __________ : _______ No Regression Fair Good	
b. Subjective rating by subject (TO BE DETERMINED AT END OF SESSION): (Read to subject and ask him to select the statement that best describes his experience:) ____1) I did not go back at all. ____2) I was thinking about when I was that age, but had no visual experience. ____3) Although I did not go back, I could see myself as a young child reliving a past experience. ____4) I knew I was really my present age, but I felt in part as though I was reliving an experience. ____5) I actually felt as though I was back at the suggested age, and reliving a past experience.	
Score (+) if hypnotist's rating is good, or if the subjective rating is 4 or 5.	(3)____

ITEM	SCORE
4. POSTHYPNOTIC SUGGESTION (Clearing throat or coughing) Note nature and degree of response. a. Hypnotist's rating: ________ Absent ________ Present ________ Exceptionally Clear	
b. Subjective rating by subject (TO BE DETERMINED AT END OF SESSION IF SUBJECT RESPONDED): You coughed (or cleared your throat) during the session. 1) Do you remember why? ________ 2) Did you know why at the time? ________ 3) If you remembered that I said you would do this, why did you carry out the suggestion? ________ 4) Would you say it was voluntary or involuntary? ________ Score (+) if hypnotist's rating is Present or Exceptionally Clear, unless subject declares response voluntary.	(4)___

ITEM	SCORE
5. POSTHYPNOTIC AMNESIA a. Please tell me now in your own words everything that has happened from the time you closed your eyes. (List items in order of mention; record descriptions of induction sensations, etc., also. If subject blocks, ask, "Anything else?" until subject reaches a further impasse.) Anything else? b. Listen carefully to my words. NOW YOU CAN REMEMBER EVERYTHING. Anything else now? (List in order of mention.) Remind subject of omitted items. List these also, and add any remarks on nature of amnesic experience. Score (+) if subject recalls no more than two items before memory is restored.	(5)___
(Complete inquiry on items 3 and 4 at end of session.) TOTAL SCORE	___

Appendix 8

PHOTOGRAPHIC REPRODUCTION OF ACTUAL ANTARCTIC EEG TRACING



Appendix 9

Table 11

SUBJECT VOLTAGES AT FOUR SKIN RESISTANCE

LEVELS FOR LAFAYETTE SHOCKER MODEL #82450

Shocker Setting	100 kΩ	200 kΩ	500 kΩ	1 meg Ω
0	.14	.15	.12	.12
5	.2	.2	.19	.19
10	.34	.35	.29	.28
15	40	45	40	40
20	100	110	100	100
25	160	165	160	170
30	210	225	220	220
35	250	270	270	270
40	290	310	320	320
45	400	360	380	380
50	420	400	440	440
55	460	440	480	490
60	520	500	530	540
65	550	520	580	610
70	570	560	620	660
75	590	600	660	720
80	610	620	710	780
85	640	660	760	860
90	670	700	860	920
95	700	720	900	940
100	710	740	920	980
105	720	750	930	1000

The above data was obtained with the assistance of Howard Paterson, Senior Technician, University of Canterbury. Voltage measurements were peak-to-peak output pulses with estimated measurement accuracy of 5% or better. Pulse width was found to be 5 msec with 40 pulses per sec. Lafayette's original 1-10 scale was re-scaled 0-105. The "105" setting represents the full clockwise potentiometer setting and "0" the full counterclockwise position

Appendix 10

Publications

Consistent with University of Canterbury course regulations for the Ph.D. (University of Canterbury 1980 Calendar, p. 204) three publications resulting from the research completed for this thesis are reproduced in this Appendix.

The International Journal of Clinical and Experimental Hypnosis
1980, Vol. XXVIII, No. 1, 63-74

EEG ALPHA, SKIN CONDUCTANCE AND HYPNOTIZABILITY IN ANTARCTICA[1]

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Abstract: On the basis of alternative hypotheses in the literature, 9 invited Ss undergoing wintering-over isolation at Scott Base, Antarctica, were tested for EEG alpha and hypnotizability. 8-channels of EEG, bipolar skin conductance (SC) and hypnotizability data were collected at Scott Base prior to and following the wintering-over isolation. Significant increases in alpha density and hypnotizability were found in Ss following isolation. The previously reported relationship between simple eyes closed alpha density and hypnotizability was not found prior to isolation; however, this correlation approached significance following isolation. The possible influence of psychophysiological arousability on baseline EEG alpha records was considered. Correction of EEG records using SC indices of arousal resulted in a significant correlation between EEG alpha and hypnotizability following isolation. A tendency toward significance was evident in the pre-isolation, SC corrected, correlation. The significant influence of environment on EEG alpha and hypnotizability is discussed as is the use of SC arousal indices to enhance EEG alpha/hypnotizability correlations.

In Zubek's (1973) review of the effects of prolonged sensory and perceptual deprivation, the slowing of EEG activity was reported in several investigations. The extent of alpha frequency slowing has been reliably shown to be dependent upon deprivation conditions. Engstrom (1976) suggested that the restriction of sensory experience may be a variable basic to hypnosis. He noted that skills involved in becoming hypnotized may include S's predisposition to restrict sensory input because of lower levels of cortical arousal. Even in active-alert hypnotic

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[2]The author wishes to thank the United States Naval Support Force, Antarctica and the United States Air Force Military Airlift Command for logistics support and Professor R. A. M. Gregson, University of Canterbury, for his generous support throughout the project.

[3]Reprint requests should be addressed to Arreed F. Barabasz, Ed.D., Director, Clinical Psychology, Department of Psychology, University of Canterbury, Christchurch 1, New Zealand.

induction (Bányai & E.R. Hilgard, 1976), focused attention seems to be a common characteristic. In this study, it was noted that although eyes remained open in the alert induction, the gaze appeared unfocused, as though *S* was staring at some distant object. *Ss* reported the ability to "tune other things around me out [p. 222]."

Several studies have shown a significant, positive relationship between waking eyes closed alpha density and hypnotizability (Cooper & London, 1976; Edmonston & Grotevant, 1975; Engstrom, 1970; E. R. Hilgard & J. R. Hilgard, 1975; London, Hart, & Leibovitz, 1968; Morgan, Macdonald, & E. R. Hilgard, 1974; Morgan, McDonald, & Macdonald, 1971; Nowlis & Rhead, 1968). Other studies have failed to support a positive correlation between alpha and susceptibility (Dumas, 1976; Dumas & Morgan, 1975; Evans, 1972; Galbraith, London, Leibovitz, Cooper, & Hart, 1970). Crosson, Meinz, Laur, Williams, & Andreychuk (1977) found a significant correlation between eyes open alpha and hypnotic susceptibility, but only when computation was based on the highest period of alpha during baseline. Alpha rhythm has typically been recorded from only a single site. Electrode placements have been inconsistent ranging from frontal to occipital sites.

On the basis of a review of the literature, Dumas (1977) concluded that the only consistent covariate of the alpha-hypnotizability correlation was the method by which *Ss* were selected. In experiments where the sample consisted of non-naive volunteers, there was a significant correlation, while investigations using invited *Ss* or *Ss* unaware of the experimental focus found no correlation. A correlation results when *Ss* volunteer for a "brainwave and hypnosis" study, but no such relationship is evidenced when *Ss* are drafted. It was concluded that *S* self-selection, based on the invitation to participate voluntarily versus coercion is primarily responsible for alpha-hypnotizability correlations. The operation of S self-selection might be viewed as a variable related to personality.

In contrast to the findings of environmental influences on alpha EEG as reviewed by Zubek (1963, 1973) and Engstrom's (1976) suggestion that sensory restriction may be basic to hypnosis, the review by Dumas (1977) reveals the variable of S self-selection according to the invitation to hypnosis. The Dumas (1977) finding is of particular interest when viewed in the context of earlier research on hypnotic susceptibility and personality. Numerous studies have been conducted using scales such as the California Psychological Inventory (Gough, 1956), the 16 Personality Factor Questionnaire (Cattell & Eber, 1949), the Guilford-Zimmerman Aptitude Survey (Guilford & Zimmerman, 1947), and the Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1942). The studies have been reviewed by E. R. Hilgard (1965), Barber

(1969), and Engstrom (1976). Generally, no significant relatedness to hypnotizability was found. The few significant correlations yielded were of very limited predictive utility. E. R. Hilgard (1965) suggested that the personality inventories used may not adequately sample content areas related to susceptibility. Tellegen and Atkinson (1974) cited the evidence that such purportedly multidimensional scales are saturated with only the dimensions of Stability versus Neuroticism and Introversion versus Extroversion. A third personality variable "Absorption"—or the imperviousness to distracting events—was found to have a low but consistent correlation with hypnotizability.

In summary, Dumas (1977) has concluded that *S* self-selection based on the invitation to participate voluntarily versus coercion by class requirements is primarily responsible for alpha-hypnotizability correlations. Alternatively, Engstrom (1976) suggested that the demonstrated interrelationships between sensory restriction, an environmental variable, with slowing of EEG, and skills involved in becoming hypnotized converge on the direct evidence of correlation between hypnotizability and EEG.

The purpose of the present study was to investigate the stability of EEG alpha and hypnotizability employing invited *S*s, unaware of the experimental focus, who experienced a prolonged, but limited restriction of sensory and perceptual stimulation. In the light of the data and discussion presented above, it seemed appropriate to advance the following alternative and conflicting a priori hypotheses: (*a*) On the basis of Dumas's (1977) findings, EEG alpha density would not be significantly correlated with hypnotizability either prior to or following environmental deprivation. (*b*) On the basis of Engstrom's (1976) findings, EEG alpha density would show a significant correlation with hypnotizability and there would be an increase in alpha density and hypnotizability following exposure to environmental deprivation.

An additional purpose of the present investigation was to determine whether or not alpha-hypnotizability correlations could be enhanced for invited *S*s by omitting portions of EEG records coincident with skin conductance indices of arousal. Psychophysiological arousal, vigilance, or even relatively simple cognitive tasks have been shown by numerous studies to be incompatible with alpha production (Enslein, Beatty, Grossberg, Cohen, Chapman, Vidal, Rebert, 1975). Electrodermal response indices have been found to be negatively correlated with alpha production (Pelletier & Peper, 1977). It was hypothesized that Dumas's (1977) consistent findings of no correlation between alpha and hypnotizability might be accounted for by the suppression of *S*s typical eyes closed alpha due to arousal. Crosson et al. (1977) suggested that arousal responses in a novel environment, soon after having electrodes attached, could block alpha activity. It could be expected that naive or invited Ss might demonstrate greater psychophysiological arousal during experimentation than informed volunteers.

METHOD

Subjects

Invited Ss, naive with respect to the focus of the investigation, consisted of 9 of the 10 men wintering-over at Scott Base, Antarctica. The tenth man was unable to participate in the study due to logistics factors. This New Zealand station is located near McMurdo Sound, 1300 km from the South Pole. The Ss were told only that they were participating in a study of stability of various psychophysiological and psychometric responses. The sample—consisting mainly of scientific technicians, engineers, mechanics, and an electrician—was considered to be technologically orientated. Prewinter hypnotizability scores, on the instrument described later in this paper, were significantly lower ($p < .05$) on a Wilcoxon contrast than the scores for a group of 34 upper level university students.

Apparatus

Eight channels of EEG activity were simultaneously recorded on a San-Ei 1A61 electroencelphalograph[4] at a sensitivity of 2.5 mm/50 μV. A paper speed of 3 cm/second was used with the ninth channel time constant set to 0.3. Recordings were monopolar employing the left and right earlobes for reference sites. Electrodes were placed in compliance with the International 10-20 system at left and right frontal (F3 and F4), left and right temporal (T3 and T4), left and right parietal (P3 and P4), and left and right occipital (01 and 02).

Beckman silver/silver chloride electrodes were used for frontal, earlobe, and earthing sites. Wire scalp electrodes were placed with bentonite paste for temporal, parietal, and occipital sites. Electrode type/placement combinations were formulated to maximize signal to noise ratio on the basis of pre-investigation experiments with inmate volunteers from Paparua Prison, Christchurch, New Zealand. Electrode to skin contact conditions were monitored simultaneously for all sites on the light emitting diode display board of the San-Ei 1A61. Maximum acceptable scalp to reference electrode resistance was 15 k ohms. All electrode placements were completed by the present investigator to maximize consistency of site location.

[4]Special thanks are expressed to the San-Ei Instrument Corporation, Tokyo, Japan for the 1A61 Electroencephalographic equipment grant.

Skin conductance (SC) was also monitored during EEG recording sessions. Beckman silver/silver chloride electrodes were attached to the medial phalanx (Edelberg, 1967) on the volar surface of each S's second and third digits following the Barabasz (1977) standardized procedure. The SC measures were amplified by a 76441 conductance amplifier removed from a Lafayette Instruments Barabasz Desensitization Quantifier. Recordings were made on a Lafayette 76012 Datagraph. The SC sensitivity was set at 0.1 μmho/cm. Chart speed was set at 2.5 mm/second.

Hypnotizability Instrument

In order to help preserve the naivete of Ss for the pre- and posttest measures, the Barber Suggestibility Scale (BSS) of Barber and Glass (1962) was selected as the measure of hypnotizability. In contrast to other reliable scales, such as the Stanford Hypnotic Susceptibility Scale, Form A (Weitzenhoffer & E. R. Hilgard, 1959), or the Harvard Group Scale of Hypnotic Susceptibility, Form A (Shor & E. Orne, 1962), BSS can be administered without induction of hypnosis. On the basis of a pilot study (Barabasz, 1976) employing a Solomon four-group design, it was determined that even the use of BSS resulted in significant alteration of Ss' awareness of the hypnotic focus of the study. Since it was the aim of the present study to maintain naivete of Ss and to minimize potential habituation effects, the BSS was not used in its entirety. Items (1) Arm Lowering, (2) Arm Levitation, and (4) Thirst Hallucination were found to correlate significantly with full scale suggestibility scores while showing no significant influence on Ss naivete regarding focus of the measures. Items (1) and (2) were scored on the basis of inches of arm movement (Barabasz, 1976).

The present study employed items (1) and (2) of BSS as described above. Item (4) was modified by eliminating the portion which asks S to imagine himself in the hot sun for hours. On the basis of face validity, it was assumed that the hot summer sun image would not be relevant for wintering-over staff in the twelfth month in Antarctica. At the time of posttesting, indoor passageways at Scott Base were at an ambient temperature of $-32\,^{\circ}$C. Item (4) was limited to the scoring of the swallowing response upon imagination of the drinking of a refreshing glass of water.

The modified BSS and the Stanford Hypnotic Clinical Scale (SHCS) of Morgan and J. R. Hilgard (1975) were administered to 34 upper level students enrolled at the University of Canterbury, New Zealand. A rank order correlation between the measures was significant ($r = .37$, $p < .05$). Broad (1979) independently found a significant correlation ($r = .42$, $p < .05$) between the modified BSS and SHCS with an N of 20.

Procedure

All tests were conducted at Scott Base, Antarctica. A previous study (Simmonds, 1974) demonstrated the impracticality of attempting to test men before they departed from New Zealand and after they returned. Hypnotizability, EEG, and SC data were collected 8 weeks after Ss arrived at Scott Base and 10 months later. The actual wintering period is over 7 months duration and there are no flights or ships during this time. The only contact with the outside world was by intermittent radio communication. The second testing immediately followed the period of isolation during the long, dark Antarctic winter.

Following attachment of EEG and SC electrodes, Ss were helped on to a bed in the small sick bay room of the base. An exhaust fan served to mask extraneous noises. Each S's maximum SC level was established following standardized procedure; detailed descriptions are reported elsewhere (Barabasz, 1977; Lykken & Venables, 1971; Prokasy & Raskin, 1973). The Ss were then asked to close their eyes and relax to the best of their ability while EEG and electrodermal data were recorded.

A relatively long recording period—typically 25 minutes—was chosen to help correct for possible novelty effects on alpha production. Eye movement muscle artifacts in the frontal records were used to help correct for onset of sleep. Sleep onset occurred for the same three Ss in pre- and postwinter testing sessions. In these instances, Ss were awakened verbally and their recording periods were extended to allow for a 3- to 4-minute settling period after arousal.

After the recording period, electrodes were removed and hypnotizability measures were administered. Without attempted induction of hypnosis, Ss were then told that the remaining tests were all tests of imagination. "The better you can imagine and the harder you try, the more you'll respond. Try as hard as you can to concentrate, and to imagine the things I tell you to [Barber & Glass, 1962; p. 222]."

Scoring

The EEG alpha (8-13 Hz greater than approximately 20 μV) data for all eight channels was hand scored using a San-Ei precision frequency templet. Two independent scorers who were blind to the purpose of the investigation were used. Records were scored for total percent-alpha and for total percent-alpha less the portion of each record during which Ss demonstrated SC arousal responses and less the 3-4 minutes following awakening for Ss exhibiting sleep onset.

All channels, except frontals, were averaged in determining total percent-alpha. Frontal data was omitted because of between scorer inconsistency apparently related to artifact interpretation. An SC arousal response was operationally defined as a pen deflection amounting to

50% or greater of S's maximum SC response based on the Lykken and Venables (1971) startle response procedure.

The three hypnotizability tests were scored on a 0-3 point basis for each item. Arm lowering and arm levitation were scored 1 point for 4"-8" response, 2 points for 8+"-12", and 3 points for 12+" and over. The swallowing response/drinking of water item was scored 1 point for a single swallow *or* mouth movements, 2 points for more than one swallow *or* one swallow combined with mouth movements. An additional point was given if S reported that it "actually felt like I was drinking a glass of water" during posttest questioning.

Results

The Ss' prewintering-over and postwintering-over hypnotizability scores were analyzed using a Wilcoxon Matched-Pairs Signed-Ranks test. A significant increase in hypnotizability was found (Wilcoxon $T=3$; $Ns-R=8$, $p<.05$). Rank order correlations were performed for hypnotizability scores and percent-alpha and for hypnotizability and percent-alpha omitting portions of EEG record coincident with SC arousal indices.

The results for pre- and postwintering-over periods appear in Table 1. The results show a significant ($p<.01$) correlation between percent-alpha per record, less periods of SC arousal, and hypnotizability for Ss exposed to Antarctic wintering-over isolation. Correlations for prewinter SC corrected alpha and postwinter uncorrected alpha showed a tendency toward significance ($.05<p<.1$). No significant correlation was demonstrated for the prewinter total percent-alpha data.

TABLE 1

Percent-Alpha and Hypnotizability Correlations for Antarctic Wintering-Over Party

Period	Total Percent-Alpha	Percent-Alpha Corrected for SC Arousal Periods
Prewinter Isolation	.21	.61*
Postwinter Isolation	.58*	.86**

*$.05<p<.10$.
**$p<.01$.

Pre- versus postwintering-over percent-alpha scores and SC corrected percent-alpha scores were compared by a t test for matched samples. The results appear in Table 2.

These results demonstrate significant ($p<.01$) increases in alpha density for total percent-alpha and SC corrected percent-alpha following wintering-over isolation.

TABLE 2

ALPHA DENSITY *t* TEST RESULTS FOR WINTERING-OVER PARTY

Contrast	*N*	$\bar{X}$ Percent-Alpha	*S.D.*	*t* Value
Prewinter Total Alpha	9	32.00	15.44	
versus				4.78*
Postwinter Total Alpha	9	44.22	18.81	
Prewinter SC-corrected Alpha	9	38.33	17.17	
versus				3.53*
Postwinter SC-corrected Alpha	9	49.44	21.54	

*$p < .01$.

The *t* test results were subjected to Omega square analysis. An $\omega^2 = .54$ was found for the total alpha density comparison and an $\omega^2 = .39$ was found for SC corrected alpha density comparison. Both Omega square results showed a relatively high degree of statistical association from the data.

DISCUSSION

The present study supports the hypothesis that a significant relationship exists between hypnotizability and EEG alpha density. A significant increase in alpha density and hypnotizability was found following the restriction of sensory and perceptual input for an extended period of time while wintering-over at Scott Base, Antarctica. The results appear to support the view that environmental factors or their interaction with another personality factor, choosing to winter-over in Antarctica, can significantly influence hypnotizability and waking eyes closed alpha density.

The Ss were drafted for both pre- and posttesting sessions and the 10-month period between sessions seemed adequate to control for potential effects from pretesting. Informal interviews conducted with all Ss following all data collection failed to reveal any awareness of attitudinal change but preservation of naivete seemed to be confirmed. In posttesting, Ss' ability to recall aspects of the pretest was noted. The majority of Ss recalled ". . . putting wires or electrodes on the scalp," but failed to recall the "test of imagination."

It is of interest to note that had this study been limited to a simple total alpha density and hypnotizability measure for invited Ss—prior to wintering-over isolation—the results would have appeared to further support Dumas's (1977) findings. Such conditions were similar to those of the invited Ss studies performed earlier.

The long EEG/SC recording period control for novelty was apparently unnecessary. No significant differences were found between SC corrected alpha density for the first versus last 5 minutes of recording in pre- or postwinter comparisons.

The Crosson et al. (1977) suggestion that arousal responses could block alpha activity was supported. While the total percent-alpha and hypnotizability correlation approached significance in the postwintering-over testing period, the omission of portions of EEG record coincident with SC arousal indices appeared to greatly enhance this correlation. The SC correction procedure also enhanced the prewintering-over correlation. Further enhancement of EEG alpha and hypnotizability correlations might be obtained by additional refinement of SC criteria of arousability. On the basis of postexperimental trials, it was also concluded that electrode placement at the left or right outer canthi would be more useful than the frontals for the detection of sleep onset by eye roll artifacts.

The Scott Base, Antarctica situation provided an ideal environment for restriction of sensory and perceptual input over time, while maintaining naivete of Ss with respect to the focus of the experiment. The possibility of conducting high quality multiple channel EEG measures in a cramped and electrically unscreened remote base has been demonstrated to be possible using modern equipment. Further investigations aimed at identifying specific environmental factors relevant to the enhancement of hypnotizability are planned. The focus will be on summer Antarctic field parties where deprivation is more acute, but for only 1 or 2 months duration. It is also hoped that an FM tape-recording of EEG signals can be taken in addition to the standard analog record. This would provide the basis for later computer spectral analysis outside Antarctica. Under such circumstances, the establishment of multiple baselines might be worthwhile.

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EEG-Alpha, Leitfähigkeit der Haut und Hypnotisierbarkeit in der Antarktis

Arreed F. Barabasz

Abstrakt: Auf Grund von alternativen Hypothesen, die in der Literatur auftauchen, wurden 9 *Vpn.*, die zum Überwintern in Isolierung auf dem Scott Stützpunkt in der Antarktis eingeladen waren, auf EEG-Alpha und Hypnotisierbarkeit geprüft. Man sammelte auf dem Scott Stützpunkt Einzelheiten über 8 EEG-Gänge, zweipolige Hautleitfähigkeit (SC = skin conductance) und Hypnotisierbarkeit vor und nach der überwinternden Isolierung. Eine bedeutende Steigerung der Alphadichte und Hypnotisierbarkeit wurde bei den *Vpn.* nach der Isolierung gefunden. Die zuvor berichtete Beziehung zwischen Alphadichte mit einfach geschlossenen Augen und Hypnotisierbarkeit zeigte sich vor der Isolierung nicht, doch näherte sich diese Korrelation dem Grad der Bedeutung nach der Isolierung. Man zog daher den möglichen Einfluss einer psychophysiologischen Erreglichkeit auf grundlinige EEG-Alpharesultate in Betracht. Eine Korrektur der EEG-Resultate mittels SC-Anhaltspunkten für Erreglichkeit resultierte in einer bedeutenden Korrelation zwischen EEG-Alpha und Hypnotisierbarkeit als Folge der Isolierung. Eine Tendenz zur Bedeutsamkeit wurde in der vor der Isolierung, auf SC korregierten Korrelation offenbar. So diskutiert man hier den bedeutenden Einfluss der Umgebung auf das EEG-Alpha und Hypnotisierbarkeit in Bezug auf Anwendung von SC-Erreglichkeitspunkten, um die Korrelation zwischen EEG-Alpha/Hypnotisierbarkeit zu steigern.

Rapports entre les ondes cérébrales alpha, la conductance électro-dermale et l'hypnotisabilité dans l'Antarctique

Arreed F. Barahasz

Résumé: Partant d'hypothèses diverses rapportées dans la littérature, l'auteur a évalué la susceptibilité hypnotique et l'EEG des ondes alpha de 9 Ss isolés durant l'hiver à la base Scott, dans l'Antarctique. L'auteur a compilé les données de huit canaux d'EEG, la conductance électro-dermale bipolaire et la susceptibilité hypnotique, à la base Scott, avant et après l'isolation hivernale. On a observé, chez les Ss, une augmentation significative de la densité des ondes alpha et de l'hypnotisabilité, suite à l'isolation. On n'a pas trouvé, avant l'isolation, la relation déjà établie entre la densité des ondes alpha, lors de la simple fermeture des yeux, et l'hypnotisabilité; toutefois, cette corrélation se rapprochait du seuil de signification, après l'isolation. L'auteur reconnaît l'influence possible de la fonction d'alerte psycho-physiologique sur l'EEG de base des ondes alpha. L'analyse de l'EEG obtenu suite à l'isolation, utilisant la conductance électro-dermale bipolaire comme indice de vigilance, a montré une corrélation significative entre l'EEG des ondes alpha et la susceptibilité hypnotique. Une tendance vers un seuil significatif de la corrélation pré-isolation est devenue évidente, lorsque la conductance électro-dermale bipolaire a été utilisée comme facteur de correction. L'auteur discute l'influence significative de

l'environnement sur l'EEG des ondes alpha et l'hypnotisabilité, de même que l'utilisation de la conductance électro-dermale en tant qu'indice de vigilance permettant de révéler les corrélations entre l'EEG des ondes alpha et l'hypnotisabilité.

Relación entre las ondas cerebrales Alfa, la conductancia electro-dermal y la susceptibilidad hipnótica en Antartide

Arreed F. Barabasz

Resumen: Saliendo de diferentes hipotesis encontradas en la literatura, el autor ha valuado la susceptibilidad hipnótica y el EEG de las ondas Alfa de 9 Ss segregados durante todo el invierno a la base Scott, en Antartide. El autor ha compilado los datos de 8 canales de EEG, la conductancia electro-dermal bipolar y la susceptibilidad hipnótica a la base Scott, antes y después de la segregación invernal. Se ha observado una subida significativa de la densidad de las ondas alfa y de la hipnotizabilidad, después de la segregación. No se ha encontrado, antes de la segregación, la relación ya establecida entre la densidad de las ondas alfa y la hipnotizabilidad; pero esta correlación ha obtenido un nivel significativo después de la segregación. El autor reconoce la probable influencia de la función de alerta psico-fisiológica sobre el EEG de base de las ondas alfa. El análisis del EEG obtenido después de la segregación, sirviéndose de la conductancia electro-dermal bipolar como indice de vigilancia, ha mostrado una correlación significativa entre el EEG de las ondas alfa y la susceptibilidad hipnótica. Cuando se ha utilizado la conductancia electro-dermal bipolar como factor de correción, se ha hecho evidente una tendencia muy significativa de la correlación pre-segregación. El autor discute la influencia significativa del ambiente sobre el EEG-Alfa y la susceptibilidad hipnótica.

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ISOLATION, EEG ALPHA AND HYPNOTIZABILITY IN ANTARCTICA

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The motivation for this study arose from the discrepancy between self report studies (Mullin, 1960) (Rivolier, 1976) about impairment of memory and difficulty in concentrating following Antarctic wintering-over isolation and objective measures (Gregson 1978a, 1978b) of actual pre-post winter performance showing, slight improvements rather than decrements. An investigation of EEG responses to veridical and suggested olfactory stimuli was conducted on an Antarctic wintering-over party (Barabasz & Gregson, 1978). Suppression of EEG amplitude, consequent upon stimulation, decreased for veridical odorants following wintering-over, but suppression consequent upon suggested odorants increased. This finding was viewed as supportive of a shift in suggestibility following winter isolation. Such a suggestibility shift might account for self reports of performance decrements, considering the recurrent iconography of base decor and literature featuring Antarctic explorers suffering and dying under stress.

Antarctic wintering-over isolation involves a considerable degree of sensory restriction, including total lack of diurnal variation for 4 months of the period. Olfactory stimulation is severely limited by the anosmic sub zero working environment. During the winter period there are no flights or ships and intermittent radio contact constitutes the only communication with the outside world.

Engstrom (1976) suggested that restriction of sensory experience may be a variable basic to hypnosis and skills involved in becoming hypnotised may include a subject's predisposition to restrict sensory input because of lower levels of cortical arousal. In Zubek's (1973) review of the effects of prolonged sensory and perceptual deprivation the slowing of EEG activity was reported in several investigations. The extent of alpha frequency slowing has been reliably shown to be dependent upon deprivation conditions.

Several studies have shown a significant positive relationship between waking eyes closed alpha density and hypnotizability while others have failed to support such a correlation (Barabasz, 1979). Dumas (1977) suggested that in experiments where the sample consisted of non-naive volunteers there was a significant correlation, while investigations using invited subjects or subjects unaware of the experimental focus found no correlation. A correlation results when subjects volunteer for a "brainwave and hypnosis" study but no such relationship is evidenced when subjects are drafted. It was hypothesized that subject self-selection, rather than environmental factors, is primarily responsible for alpha-hypnotizability correlations.

It seemed that further study of potential suggestibility shifts in Antarctica might eventually help to explain discrepancies in self report versus objective test performance. The environment was also considered to be an ideal laboratory for testing the Dumas hypothesis. The purpose of this study was to investigate the stability of EEG alpha and hypnotizability employing invited subjects, unaware of the experimental focus, who experienced a prolonged, but limited restriction of sensory and perceptual stimulation.

An additional purpose of the investigation was to determine whether or not alpha-hypnotizability correlations could be enhanced for invited subjects by omitting portions of EEG records coincident with skin conductance indices of arousal. Psychophysiological arousal, vigilance or even relatively simple cognitive tasks have been shown by numerous studies to be incompatible with alpha production (Beatty, 1975). Electrodermal response indices have been found to be negatively correlated with alpha production (Pelletier and Peper, 1977). It was hypothesized that Dumas' (1977) consistent findings of no correlation between alpha and hypnotizability might be accounted for by the suppression of Ss typical eyes closed alpha due to arousal. Crosson et al (1977) suggested that arousal responses in a novel environment, soon after having electrodes attached, could block alpha activity. It could be expected that naive or invited subjects might demonstrate greater psychophysiological arousal during experimentation than informed volunteers.

METHOD

Subjects - Invited Ss, naive with respect to the focus of the investigation consisted of nine men wintering-over at Scott Base, Antarctica. This New Zealand station is located near McMurdo Sound, 1300 km from the South Pole. Ss were told only that they were participating in a study of stability of various psychophysiological and psychometric responses. The sample was considered to be technologically oriented. Pre-winter hypnotizability scores, on the instrument described later, were significantly lower ($p < .05$) on a Wilcoxon contrast than a group of 34 upper level university students.

Apparatus - Eight channels of EEG activity were simultaneously recorded on a San-Ei 1A61 electroencephalograph[1] at a sensitivity of 5 mm/50 μ volts and chart speed of 3 cm/second. Recordings were monopolar employing the left and right earlobes for reference sites. Electrodes were placed in compliance with the International 10-20 system at left and right frontal (F3 and F4), left and right temporal (T3 and T4), left and right parietal (P3 and P4) and left and right occipital (01 and 02).

Beckman silver/silver chloride electrodes were used for frontal, earlobe and earthing sites. Wire scalp electrodes were placed with bentonite paste for temporal, parietal and occipital sites. Electrode to skin contact conditions were monitored for all sites on the San-Ei LED display board. Maximum scalp to reference electrode resistance was 15 k ohms.

Skin conductance (SC) was also monitored during EEG recording sessions. Beckman silver/silver chloride electrodes were attached to the medial phalanx on the volar surface of each S's second and third digits following standardized procedure. SC measures were recorded on a Lafayette 76100-30 Barabasz Desensitization Quantifier. SC sensitivity was set at 0.1 μmho per centimeter.

Hypnotizability Instrument - To help preserve the naivete of the Ss for the pre and post test measure the Barber Suggestibility Scale (BSS) Barber and Glass, 1962) was selected as the measure of hypnotizability.

In contrast to other scales, the BSS can be administered without induction of hypnosis. On the basis of a pilot study (Barabasz, 1976) employing a Solomon four group design, it was determined that even the use of the BSS resulted in significant alteration of the Ss' awareness of the hypnotic focus of the study. Since it was the aim of the present study to maintain naivete of Ss and to minimize potential habituation effects the BSS was not in its entirety. Item (1) Arm Lowering, (2) Arm Levitation and (4) Thirst Hallucination were found to correlate significantly with full scale suggestibility scores while showing no significant influence on Ss' naivete regarding focus of the measures. Items (1) and (2) were scored on the basis of inches of arm movement (Barabasz, 1976).

1 Special thanks are expressed to the San-Ei Instrument Corporation, Tokyo, Japan for the 1A61 Electroencephalographic equipment grant.

The present study employed items (1) and (2) of the BSS as above. Item (4) was limited to the scoring of the swallowing response upon imagination of the drinking of a refreshing glass of water.

The modified BSS and the Stanford Hypnotic Clinical Scale (SHCS) Hilgard & Hilgard, 1975) was administered to 34 upper level students enrolled at the University of Canterbury, New Zealand. A rank order correlation (.37) between the measures was significant ($p < .05$). Broad (1979) independently found a significant ($p < .05$) correlation (.42) between the modified BSS and the SHCS with an N of 20.

Procedure - All tests were conducted at Scott Base, Antarctica. Hypnotizability, EEG and SC data were collected eight weeks after Ss arrived at Scott Base and ten months later immediately following winter isolation.

Following attachment of electrodes S's maximum skin conductance level was established following standardized procedure, (Lykken and Venables, 1971). Ss closed their eyes while EEG and SC data were recorded.

A 25 minute recording period, was chosen to control for novelty effects on alpha production. Frontal records were used to help correct for onset of sleep. After the recording period, hypnotizability measures, announced only as tests of imagination, were administered without induction of hypnosis.

Scoring - EEG alpha (8-13 Hz > 20 μvolts) data for all eight channels was hand scored by two independent scorers using a San-Ei precision frequency templet. Records were scored for total percent-alpha and for total percent-alpha less the portion of each record during which Ss demonstrated SC arousal responses.

All channels, except frontals, were averaged in determining total percent-alpha. Frontal data was omitted because of between scorer inconsistency relating to artifact interpretation. An SC arousal response was operationally defined as a pen deflection amounting to 50% or greater of the S's SCR max (Lykken & Venables, 1971).

The three hypnotizability tests were scored on a 0 - 3 point basis for each item. Arm lowering and arm levitation were scored 1 pt. for 4" - 8" response, 2 pts for 8+" - 12", 3 pts for 12+" and over. The swallowing response/drinking of water item was scored 1 pt for a single swallow or mouth movements, 2 pts for more than one swallow or one swallow combined with mouth movements. An additional point was given if the S reported, "actually felt like I was drinking a glass of water" during post test questioning.

RESULTS

S's pre-wintering over and post-wintering over hypnotizability scores were analysed using a Wilcoxon Matched-Pairs Signed-Ranks test. A significant ($p < .05$) increase in hypnotizability was found (Wilcoxon T = 3 (NS - R = 8).

Rank order correlations were performed for hypnotizability scores and percent-alpha and for hypnotizability and percent-alpha omitting portions of the EEG record coincident with SC arousal indices.

TABLE 1

PERCENT-ALPHA & HYPNOTIZABILITY CORRELATIONS FOR ANTARCTIC WINTERING-OVER PARTY

Period	Total Percent-Alpha	Percent-Alpha Corrected for SC arousal periods
Pre-Winter Isolation	.21	.61*
Post-Winter Isolation	.58 *	.86 **

* $.05 < p < .1$

** $p < .01$

The results appearing in Table 1 show a significant ($p < .01$) correlation between percent-alpha per record, less periods of SC arousal, and hypnotizability for Ss exposed to Antarctic wintering-over isolation. Correlations for pre-winter SC corrected alpha and post-winter uncorrected alpha showed a tendency toward significance ($.5 < p < .1$). No significant correlation was demonstrated for the pre-winter total percent-alpha data.

Pre versus post wintering-over percent-alpha scores and SC corrected percent alpha scores were compared by a t-test for matched samples.

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TABLE 2

ALPHA DENSITY t TEST RESULTS FOR WINTERING-OVER PARTY

Contrast	N	Mean % Alpha	S.D.	t-Value
Pre-winter Total Alpha	9	32.00	15.44	
VS				4.78*
Post-Winter Total Alpha	9	44.22	18.81	
Pre-Winter SC-corrected Alpha	9	38.33	17.17	
VS				3.53*
Post-Winter SC-corrected Alpha	9	49.44	21.54	

* $p < .01$

The results appearing in Table 2 demonstrate significant ($p < .01$) increases in alpha density for total percent-alpha and SC corrected percent-alpha following wintering-over isolation.

DISCUSSION

This study supports the hypothesis that a significant relationship exists between hypnotizability and EEG alpha density. A significant increase in hypnotizability and alpha density was found following the restriction of sensory and perceptual input while wintering-over at Scott Base, Antarctica.

The study fails to support the Dumas (1977) conclusion that the personality factor of subject self-selection is primarily responsible for alpha-hypnotizability correlations. The results appear to support the view that environmental factors or their interaction with another personality factor, choosing to winter over in Antarctica, can significantly influence hypnotizability and waking eyes closed alpha density.

Ss were drafted for both pre and post testing sessions. Informal interviews conducted with all Ss following all data collection failed to reveal any awareness of attitudinal change but preservation of naivety seemed to be confirmed.

It is of interest to note that had this study been limited to a simple total alpha density and hypnotizability measure for invited Ss, prior to wintering-over isolation the results would have appeared to further support Dumas' findings.

The long EEG/SC recording period control for novelty was apparently unnecessary. No significant differences were found between SC corrected alpha density for the first versus last five minutes of recording in pre or post winter comparisons.

The Crosson et al (1977) suggestion that arousal responses could block alpha activity was supported. While the total percent-alpha and hypnotizability correlation approached significance in the post wintering-over testing period, the omission of portions of EEG record coincident with SC arousal indices appeared to greatly enhance this correlation. The SC correction procedure also enhanced the pre wintering-over correlation. Further enhancement of EEG alpha and hypnotizability correlations might be obtained by additional refinement of SC criteria of arousability.

The Scott Base, Antarctica situation provided an ideal environment for restriction of sensory and perceptual input over time while maintaining naivete of Ss with respect to the focus of the experiment. Further investigations aimed at identifying specific environmental factors relevant to the enhancement of hypnotizability are planned focusing on summer Antarctic field parties where deprivation is more acute but for only one or two months duration.

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ABSTRACT

Sensory deprivation (SD) procedures derived from Sanders and Reyher (1969) were used with 10 Ss. The Stanford Hypnotic Clinical Scale (SHCS), modified to include a post hypnotic suggestion for an analgesic reaction, and pain threshold and tolerance tests, were administered prior to SD, immediately after and 10-14 days later. Occipital EEG alpha, skin conductance, peripheral, core and chamber temperature data were collected prior to, during and after SD. A control group of 10 Ss was used to assess the effects of repeated hypnosis upon susceptibility scores and demand characteristics of the experiment. Multivariate analysis of variance results showed SHCS and pain tolerance scores to be significantly enhanced for Ss exposed to SD immediately after and 10-14 days later. Orne's (1959) post experimental inquiry technique did not reveal experimental demand characteristics that might account for the results. EEG alpha density increased significantly in deprivation, but the increase was not progressive during the deprivation period. The maintenance of hypnotizability and pain tolerance at follow-up failed to support Reyher's (1964) theory of brain function and behavioral regulation. Hilgard's (1977) neodissociation interpretation combined with J.R. Hilgard's (1974, 1979) imaginative involvement findings is viewed as a possible explanation.

SENSORY DEPRIVATION AND THE ENHANCEMENT OF HYPNOTIZABILITY : PAIN, EEG ALPHA, SKIN CONDUCTANCE AND TEMPERATURE RESPONSES

Arreed F. Barabasz

The view that hypnotic susceptibility is a generally stable trait seems supported by the literature (As, Hilgard & Weitzenhoffer, 1963; Cooper, Banford, Schubot & Tart, 1967; Leva, 1974; Levitt, Brady, Ottinger & Hinesley, 1962; Perry, 1977; Shor & Cobb, 1968). High test-retest reliability of hypnotizability scores using the same and different hypnotists as well as high correlations over hypnotizability tests with varying induction procedures and test items has been demonstrated (Hilgard, Weitzenhoffer, Landes & Moore, 1961; London, 1969; Shor, Orne & O'Connell, 1966).

Alternatively, hypnotizability has been conceptualized as modifiable and there is evidence that it can be significantly enhanced by a range of techniques (Baykushev, 1969; Diamond, 1972; Gregory & Diamond, 1973; Kinney & Sachs, 1974;

Pena, 1962; Sachs & Anderson, 1967; Sanders & Reyher, 1969; Springer, Sachs & Morrow, 1977; Wickramasekera, 1969). In the most successful of these studies, Sanders & Reyher (1969) showed significant increases in scores on the Stanford Hypnotic Susceptibility Scale (SHSS) (Weitzenhoffer & Hilgard, 1959) following six hours of sensory deprivation, or until clinical signs of deprivation, such as craving for stimulation, were evidenced.

Sanders & Reyher's (1969) findings were viewed as consistent with Reyher's (1964) psychophysiological theory of intrapsychic processes, however, an examination of the theory suggests that only the immediate post-deprivation results could be predicted. Sanders & Reyher (1969) noted that the "model [Reyher, 1964] suggests that S should not be removed from sensory deprivation prior to a hypnotic induction, as removal reactivates adaptive behaviour and its supporting level of neuronal integration". Contrary to this notion the SHSS increases were still present at follow-up testing. In a post hoc discussion Sanders & Reyher (1969) suggested that the follow-up findings might be accounted for by the theory on the basis of association of the enhanced susceptibility with the induction procedure. The explanation seems inconsistent with the prediction noted above. Reyher's (1964, p.113) theory allows for learning only in the case of rapid induction of hypnosis by post hypnotic signal. Apparently, hypnosis functions as the unconditioned stimulus for reactivation of the cortical field that generally constitutes hypnosis for a particular subject. The ability to account for rapid inductions of hypnosis by post-hypnotic signal does not, in itself, explain the maintenance of enhanced SHSS scores at follow-up. The suggestion that the enhanced susceptibility, following deprivation, was maintained because it was associated with the induction procedure implies a long term or permanent modification of the cortical field which becomes dominant during hypnosis. This seems contrary to the general notion of Reyher's (1964) theory. Unfortunately, the specific demand characteristics of the instructions could have accounted for the follow-up findings and/or the post test findings. Each S was told that the sensory deprivation session "was designed to test the effect of sensory deprivation on her ability to be hypnotized".

Leva (1974) criticised the use of the SHSS because of its heavy loading of primary suggestibility (Hilgard, 1965) ideo-motor items, despite Sanders & Reyher's (1969) finding that two of the three nonmotor items changed as much as the motor items. The SHSS was contrasted with the Stanford Profile Scales (SPS) (Weitzenhoffer & Hilgard, 1967) which are characterized by a lack of motoric items. Leva (1974) attempted to control for instructional expectations in the Sanders & Reyher (1969) study. Using only five low susceptible Ss, Leva's results were consistent with Sanders & Reyher (1969) showing an increase in SHSS scores. As predicted, however, no such increases were found on the SPS. The extent to which deprivation affects hypnotic performance was questioned in consideration of the greater item difficulty of the SPS which involves items such as age regression.

Several additional methodological criticisms have been made of the studies purporting to modify hypnotic susceptibility. These have been reviewed in detail elsewhere (Perry, 1977). Briefly, it appears that many modification studies have failed to control for or consider (1) plateau hypnotizability (Shor, Orne & O'Connell, 1962) e.g. fears may inhibit S from maximal hypnotic performance plateau until hypnosis is experienced at least once and found to be safe; (2) situational factors e.g. positive/negative motivational instructions, expectancy, (Barber & Calverly, 1964; Gregory & Diamond, 1973; Hilgard, 1965; Kroger, 1963; Levitt & Overley, 1965) (3) follow-up testing (4) generalization data

beyond that of hypnotic susceptibility test scores
(5) demand characteristics e.g. cues in the design and/or procedure which might communicate E's hypothesis and lead S to provide data confirming E's predictions (Orne, 1959). No modification study has ever employed Orne's (1959) post experimental inquiry technique in an effort to determine the influence of demand characteristics. Perry (1977) noted that there may be no other way of performing such studies without telling S that increased hypnotic performance is what E hopes to obtain. This is what most investigators have done and recent human subjects' legislation, at least in North America, serves further to complicate this necessary control.

The existence of numerous valid criticisms of the methodology of previous modification studies does not mean that hypnotizability cannot be meaningfully enhanced. This investigator was also impressed by increases in hypnotizability in a group of men who underwent wintering-over isolation in Antarctica (Barabasz, 1979, 1980). Independent of the hypnosis literature, sensory deprivation research has consistently shown increases in suggestibility (Zubek, 1969, 1973). In another Antarctic isolation study (Barabasz & Gregson, 1978, 1979) men pre- and post- wintering-over were given a series of real and suggested odors while skin conductance response (SCR) and 8 channels of EEG data were collected. Evoked potential amplitude suppression, consequent upon stimulation decreased for real odorants following wintering-over, but suppression consequent upon suggested stimulation increased. The increase in suggestibility and the shift in response to suggested stimuli seemed to indicate that the role of isolation is considerably more powerful than that required to modify responses to primary motoric items.

The purpose of this investigation was to further explore whether or not sensory deprivation enhances hypnotic performance while attempting to consider several aspects of data collection not controlled for in previous studies. A secondary purpose was to examine skin conductance level (SCL) and EEG alpha density trends while controlling for core and peripheral S temperatures. The previous studies considering SCL failed to control for potential sweat gland temperature interactions and measured only GSR which has several disadvantages (e.g. non-linearity) as compared with direct measures of SCL (Barabasz, 1977; Lykken & Venables, 1971). EEG alpha density, while popular in numerous studies of basal susceptibility, has not been considered in the context of a modification study. It was hoped that the general instructions and elaborateness of the measures for the secondary purpose would help to mask situational factors which might influence hypnotizability measures.

METHOD

Subjects

Ss consisted of upper undergraduate and graduate level female volunteers (N = 20). Ss were paid $20.NZ (equivalent to $20US) for participation. At the time of recruitment Ss were randomly divided into control ($\bar{x}$ age = 21 years 1 month; N = 10) and experimental ($\bar{x}$ age = 21 years 5 months; N = 10) groups within the constraints of scheduling. Controls were given preliminary instructions favoring an increase in hypnotizability. Controls were told the "experiment was aimed at measuring the effect of familiarity of surroundings on hypnotic susceptibility". Experimentals were given details of the psychophysiological measures to be employed in the "experiment on sensory deprivation". They were also told that some "short cognitive tests" such as memory for designs or hypnotizability would also be given to provide the student E with practice.

Major Apparatus and Experimental Setting

Two channels of EEG activity were recorded on a San-Ei 1A61 electroencephalograph. Using the International 10-20 system, Beckman silver/silver chloride miniature hat electrodes with Beckman paste were placed at 0_1 and 0_2 fixed with colodian. Left earlobe and neck earthing sites were fixed by double-sided adhesive washers. Channel 1 was monopolar (0_1 + earlobe reference). Channel 2 was bipolar ($0_1 + 0_2$). Electrode scalp resistances were at or below 15k ohms and were monitored simultaneously for all sites on the San-Ei light emitting diode display. Raw bipolar EEG was also processed by a Lafayette/ Cyborg 76771 Research EEG Feedback Unit which provided a binary signal triggering a Digital counter for signals within 8½ to 12½ Hz at a threshold of 18 μvolts. This was also the minimum useable threshold providing interrater reliabilities above .85 on the hand scored San-Ei analog record in practice sessions.

Skin conductance level (SCL) was monitored employing a Lafayette 76100-30 Barabasz Desensitization Quantifier. Beckman silver/silver chloride electrodes were attached to the second and third digits of the left hand which was nondominant for all Ss (Lykken & Venables, 1971). Chamber ambient, S's core (rectal) and S's peripheral (1st digit volar surface left hand) temperatures were measured in a Biofeedback Technology BFT 302 using the appropriate Yellow Springs 700 series probes. S's movement was monitored using a Lafayette 76100-30 equipped with a 76403 cardio-tach amplifier and 76605 piezoelectric crystal sensor. The crystal sensor was attached to S's right arm by velcro bands.

The sensory deprivation chamber 2.6L x 1.5W x 2.4H meters was sound attenuated. It was equipped with a bed, three overhead michrophones, lighting, video camera, shielded junction boxes, silent positive pressure ventilation and a S accessible push button switch which activated a buzzer and light in the adjacent lab. The intercommunication and voice activated recording system was of local construction but followed Sanders and Reyher (1969). Deprivation Ss wore Ganzfeld goggles (Pollard, Uhr & Jackson, 1963).

Procedure

Deprivation Ss were shown the monitoring equipment and were reminded of the psychophysiological focus of the study. They were also told that only one of the "practice cognitive tests" would be used because of the time constraints. Electrodes and transducers were attached in an established sequential progression while E provided social contact unrelated to the experiment. Ss inserted their own rectal temperature probes but these were checked by the female E. Ss wore cotton clothing without gloves.

Ss reclined on the chamber bed and the Stanford Hypnotic Clinical Scale (SHCS) was administered (Hilgard & Hilgard, 1975) by the female E. This instrument was chosen because (1) items such as age regression, dream, amnesia and posthypnotic suggestion are more difficult to experience than SHSS primary items (Leva, 1974); (2) it lends itself to bed reclined Ss; (3) it has demonstrated meaningful generalizability to hypnotic pain control; (4) it is reliable; and (5) it can be administered in a short period of time. Administration time was considered particularly important in the control of demand characteristics for the deprivation Ss. The SHCS was modified by adding an additional post hypnotic suggestion designed to create a glove analgesic reaction on the back of S's right hand. A pain threshold and tolerance test was added to the post administration questioning employing a Lafayette 82450 shocker. The concentric electrodes were attached to the back of S's right hand with a velcro stretch band. After the pain test the shocker electrodes were removed and Ss were asked to close their eyes for a 10 minute EEG recording which was followed by doning of Ganzfeld goggles and earphones. Sanders & Reyher's (1969) instructions were given over the earphones except all references to hypnosis were excluded. Ss were encouraged to describe their experiences to E but were told they would only receive three stock market quotes upon depressing the button provided. Low level white noise (Lafayette 15011) was then provided over the padded earphones. This served to prevent the S from receiving auditory feedback from her body movements and only minimal feedback from vocalizations. Ss remained in sensory deprivation for 6 hours or until sensory deprivation signs were evident using the Sanders & Reyher (1969) criteria. Such signs included : craving for stimulation, emotional lability, impaired secondary process, reality testing and attempts to intensify the relationship between E and S. Application of the criteria was aided by the closed circuit video system and the movement detection apparatus.

In addition to the pre deprivation session baseline, EEG was also recorded for 1 minute at 15 minute intervals, for 10 minutes at 2 hours 10 minutes in deprivation (half the $\bar{x}$ of the Sanders & Reyher (1969) deprivation period) and for 10 minutes at the termination of deprivation. Previous research (Barabasz, 1980) suggested that EEG alpha density and hypnotizability correlations could be enhanced by omitting portions of EEG record coincident with skin conductance response (SCR) measures of arousal. During EEG recordings any SCR in excess of 50% of S's startle response, calibrated in tenths of a μmho/cm, was manually noted on the EEG record (Barabasz, 1980).

SCL to the nearest μmho, chamber ambient, S's core and peripheral temperatures were also recorded at 15 minute intervals. The SHCS and pain test was re-administered at the end of the deprivation period and 10-14 days later.

In consideration of plateau susceptibility (Shor, Orne & O'Connell, 1966) a control group was included to test for the effects of repeated hypnosis upon susceptibility and demand characteristics. Instructions favored an increase in susceptibility. The procedures followed Sanders & Reyher (1969) except that a lounge setting rather than a cubicle was used. The SHCS and pain test was administered as for deprivation Ss. In order to evaluate demand characteristics, all Ss were subjected to Orne's (1959) post experimental inquiry technique.

RESULTS

Scoring

Alpha densities in the analog EEG recordings were hand scored using a San-Ei precision frequency template. Using a band width of 8-13H_z and a threshold of 8 μ volts, each one second period of record was considered separately. A score of one point was given if the majority of the one second period was within the above specification. Interrater reliability between two independent E's was .95. Only bipolar EEG was used for analysis since there was data loss for three Ss on the monopolar channel due to detachment of the earlobe electrode. Processed EEG from the Lafayette/Cyborg 76771 was scored in seconds and tenths of a second continuously for each data collection period, as the binary output triggered an electronic digital counter. Skin conductance level (SCL) measures of arousal were recorded to the nearest µmho/sq./mm of electrode area. Temperature data was recorded in degrees Fahrenheit from the digital readout of the BFT 302. The SHCS was scored on the standardized 0-5 basis. Pain threshold and tolerance levels were scored in volts corrected across measurement periods by subjects' skin resistance converted mathematically from SC levels. Threshold was based on Ss' reports of the minimum amount of stimulation detected. Tolerance was based on Ss' reports of the intensity of stimulation detected as just below the maximum they felt they could endure. The submaximal endurance instruction was found to help minimize heroism as a measurement factor in pre-experimental testing with similar Ss. Means and standard deviations from SHCS and pain scores appear in Tables 1 and 2.

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Insert Tables 1 and 2 about here

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Control Group

In order to test for the effects of repeated hypnosis, plateau susceptibility or demand characteristics upon SHCS susceptibility scores, threshold and tolerance pain levels, a multivariate analysis of variance (MANOVA) was completed. Control group pre, post and follow-up scores were used. An F of .155 ($p > .05$) was found showing no significant effects.

Deprivation Group

In order to determine whether or not sensory deprivation effects SHCS susceptibility scores, threshold, or tolerance pain scores a multivariance analysis of variance (MANOVA) was computed. All effects were tested using Wilks Lambda. A one way MANOVA was computed on pre, post and follow-up scores. The result was significant ($F = 8.855$, $p < .001$, $R = .862$). Univariate F tests and correlations with the canonical variate (r_{ux}) appear in Table 3.

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Insert Table 3 about here

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The results presented in Table 3 demonstrate significant effects for sensory deprivation on SHCS hypnotizability, pain tolerance and pain threshold. The group results of the three measures, after transformation appear in Figure 1.

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Insert Figure 1 about here

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Figure 1 shows that SHCS hypnotizability scores and pain tolerance increased after sensory deprivation and that these increases were maintained at the follow-up testing period. Pain threshold was reduced following deprivation but approached the pre-test level at the follow-up.

Since the MANOVA did not take into account repeated measures on the same Ss nor permit comparisons between the experimental and control groups univariate analyses of variance were computed between control and experimental groups for post and follow-up SHCS hypnotizability scores. F's of 50.69 ($p < .001$) and 39.34 ($p < .001$) were found respectively showing extremely strong experimental effects.

In order to test for sensory deprivation effects on psychophysiological responses a MANOVA was computed on hand scored EEG, processed EEG, Skin Conductance Level (SCL), core, and peripheral temperature measures at five time levels. Since chamber temperature could only be held within a range of $3^{o}F$ this variable was also considered with the psychophysiological measures.

The subject (S) main effect was highly significant ($F = 63.503$, $p < .001$, $R = .988$) using Wilks Lambda. The time (T) main effect was also significant ($F = 15.158$, $p < .001$, $R = .950$). Only SCL, chamber temperature and peripheral temperature measures showed significant F tests (all $p < .001$) indicating significant differences occurred among the data collection observation periods in each measure. Univariate F tests were significant at $p < .001$ for SCL, chamber temperature and peripheral temperatures and at $p < .027$ for hand scored EEG alpha.

In order to determine whether or not temperature variables accounted for hand scored EEG alpha and/or SCL responses a multivariate analysis of covariance was computed. The result failed to show a significant relationship between the two sets of variables ($\alpha = .05$, $R = .227$, $p < .824$). The small fluctuations in chamber ambient temperature ($3^{O}F$ range) did not appear to significantly influence peripheral temperature ($\bar{x}$ range = $9^{O}F$ per S). The correlation between peripheral temperature and chamber ambient temperature was not significant ($\alpha = .05$, $r = .224$).

The three hand scored EEG alpha density levels were further analyzed using Wilcoxon Signed-Ranks Tests. The non-parametric test was chosen for these final analyses because the less restrictive assumptions seemed more appropriate for data scored by the period count method. A significant decrease in alpha density occurred between pre and mid deprivation recordings (Wilcoxon $T = 1$, $N_s - R = 10$, $p < .01$). A significant increase in alpha density occurred between mid and post deprivation recordings (Wilcoxon $T = 0$, $N_s - R = 10$, $p < .01$). The pre vs post deprivation comparison was also significant (Wilcoxon $T = 7.5$, $N_s - R = 10$, $p < .05$) showing an increase in alpha density following sensory deprivation. A graphic presentation appears in Figure 2.

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Insert Figure 2 about here

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The post-experimental inquiry failed to reveal demand characteristics for the experimental group which might have influenced hypnotizability or pain scores. No experimental S recognised the actual focus of the study. Control Ss generally reflected their pre-experimental instructions. The majority of controls felt they actually "did better" on the hypnosis test but only one S improved her score by 1 point.

DISCUSSION

The major results of the study support the view that hypnotizability can be significantly and meaningfully enhanced by sensory deprivation. Indeed, some Ss who initially scored in the lower ranges became hypnotic virtuosos, attaining maximum SHCS scores, following deprivation. Although there was some loss of hypnotizability, significant enhancement effects were still present in the follow-up testing. Perhaps of more importance is the finding that the enhancement effect was significant and meaningful in its generalizability from the post hypnotic suggestion to greatly increased pain tolerance scores. The spontaneous lowering of pain threshold levels is difficult to explain since it would seem that a post hypnotic analgesia suggestion, successful in greatly raising pain tolerance, should also raise pain threshold levels. Vernon & McGill (1961) found significant increases in pain sensitivity, on electrical pain thresholds, as a result of sensory deprivation. Threshold reports in the present study were esentially reports of minimum detectable electric sensation rather than pain perception. The suggestion for analgesia apparently functioned specifically against stimulation levels that otherwise would be perceived as painful.

The enhancement of hypnotizability on the SHCS and its generalization to pain tolerance fails to support Leva (1974). The SHCS items (e.g. dream, age regression, amnesia) cannot be considered to be tapping only primary suggestibility. Furthermore, the first use of Orne's (1959) post experimental inquiry technique in a modification study revealed successful diverting of Ss' attention away from the experimental focus. Evidently, the instructions coupled with elaborate and general psychophysiological measures were accepted by all Ss. Several of the Ss were enrolled in E's psychophysiology class and this may have helped confirm plausibility of the announced experimental focus. The post experimental inquiry relating to the SHCS amnesia item is of particular interest for four Ss who passed this item in the post test and follow-up but failed it in the pre-test. It would seem that recall would be aided by the three repetitions of the SHCS but even in the case of an S who stated she made specific efforts to recall, including rehearsal prior to the follow-up, the item was clearly passed. She stated "I knew it all before hypnosis but when she asked me to do it I got confused and could only remember the counting part of the induction".

The psychophysiological data is of peripheral interest. Only SCL, peripheral temperature, chamber temperature and hand scored EEG alpha showed significant changes as a result of deprivation Significant changes in hand scored EEG alpha densities and SCL were not accounted for by temperature variables. Fluctuations in chamber ambient temperature did not appear to signficantly influence Ss' peripheral temperature.

Consistent with a previous study of Antarctic isolation (Barabasz, 1979, 1980) there was a significant increase in EEG alpha density from pre to post deprivation, but this slowing was not progressive as suggested by Zubek (1969). Mid-deprivation EEG alpha densities were significantly lower than either pre or post deprivation levels. This finding is consistent with Nagatsuka and Kokubun's (1964) conclusion that EEG slowing was not progressive during deprivation. The failure of the machine scored EEG alpha, a technique growing in popularity, to show significant trends demonstrated the necessity of collecting conventional analog records to help control for artifacts.

The maintenance of significant follow-up enhancement effects in the absence of demand characteristics fails to support Reyher's (1964) theory. Reyher (1964) reasoned that hypnosis and sensory deprivation are manifestations of the ascendance of lower levels of neural integration in the organization of brain functions and behavioral regulation. Adaptive behavior was viewed as a function of high neuronal integration. Conditions which eliminate or homogenize sensory input prevent adaptive behavior with adaptive neuronal integration replaced by a phylogenetically older and lower level of integration. Removal from sensory deprivation should then reactive higher neuronal integration and adaptive behavior. This would predict a return to pre-deprivation hypnotizability scores at the later follow-up.

The post-deprivation and follow-up enhancement effects might be explained by E.R. Hilgard's (1977) neodissociation interpretation of hypnosis when combined with J.R. Hilgard's (1974, 1979) imaginative involvement findings. It appears to the present author that sensory restriction forces the organism to focus, perhaps as seldom before, on internally generated imaginal activity. This defensive maneuver might be conceptualized as a dissociative reaction which serves to maintain neural integration in the organization of brain functions. J.R. Hilgard (1974, 1979) found imaginative involvement and strict childhood discipline to be positively related to high hypnotizability which could not be explained by conformity behavior. Apparently, the child learned to mitigate the effectiveness of punishment through the imaginal involvement of practiced dissociation. Perhaps, the subjects in the present study learned to develop imaginative involvements in deprivation as a mechanism for coping with reduced outside stimulation. Consistent with J.R. Hilgard's (1974, 1979) findings these skills, once learned, may account for higher levels of hypnotizability and the maintenance of this talent over time.

REFERENCES

Refer to body of thesis pages 148 to 174 for references.

FOOTNOTES

1. This project was partially supported by the Medical Research Council, New Zealand and University grant U.G.C. Nos. 79-3-35 and C79-52. Thanks are also expressed to the San-Ei Instrument Co., Tokyo, Japan for the electroencephalographic equipment grant.

2. Special thanks are due Kerry-Anne Abelson who served as research assistant as a part of a Bachelor of Science honours degree research requirement. The author would also like to thank Erika Fromm and Ernest R. Hilgard for their comments on an earlier draft of the manuscript.

3. A portion of this paper was presented at the <u>2nd European Congress of Hypnosis in Psychotherapy and Psychosomatic Medicine</u>, May 12-18, 1980, Dubrovnik, Yugoslavia.

4. An extended report (172 pages) of this project is available ($US5.00 prepaid only) from the Department of Psychology, University of Canterbury, Christchurch 1, New Zealand. Request Research Project 35/36 University of Canterbury Press, 1981.

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR SHCS SCORES

Group	Pre-Treatment		Post-treatment		Follow-up	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Sensory deprivation	1.7	.82	4.2	.78	4.0	.66
Control	1.7	.82	1.6	.84	1.7	.94

TABLE 2

MEANS AND STANDARD DEVIATIONS FOR SENSORY DEPRIVATION SUBJECT'S PAIN SCORES

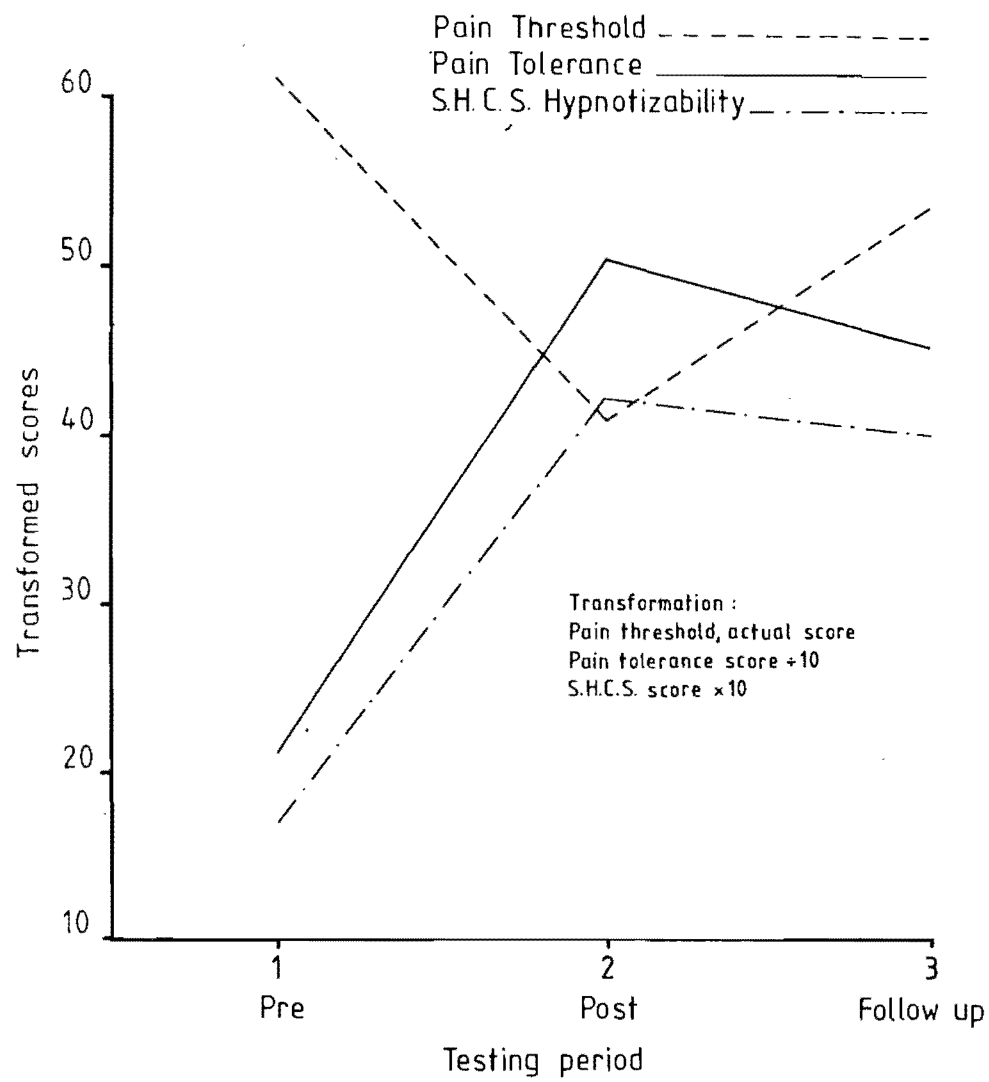
Pain Measure	Pre-treatment		Post-treatment		Follow-up	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Threshold	61.5	24.04	41.0	11.97	53.5	15.64
Tolerance	210.0	69.40	507.0	183.06	450.4	168.20

TABLE 3

UNIVARIATE EFFECTS SUMMARY FOR SHCS SCORES, PAIN THRESHOLD AND TOLERANCE LEVELS

Measure	F	$p <$	r_{ux}
SHCS Score	33.191	.001	- .921
Pain Tolerance	11.298	.001	- .538
Pain Threshold	3.315	.052	+ .254

FIGURE 1 TRANSFORMED COMPARISON OF S.H.C.S. HYPNOTIZABILITY SCORES PAIN THRESHOLD AND TOLERANCE LEVELS



Note: Only the shape of the curves may be meaningfully compared

FIGURE 2 OCCIPITAL EEG ALPHA DENSITIES PRE MID AND POST SENSORY DEPRIVATION FOR 10 MINUTE RECORDINGS