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The Use of Twilight Training in the Treatment of Cigarette Smoking Behavior

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THE USE OF TWILIGHT TRAINING IN THE TREATMENT OF CIGARETTE SMOKING BEHAVIOR

by

John Joseph Seltenreich III

A Thesis Submitted to the Faculty of the Graduate College in partial fulfillment of the requirements of the Degree of Master of Arts Department of Psychology

Western Michigan University Kalamazoo, Michigan August 1982
THE USE OF TWILIGHT TRAINING IN THE TREATMENT
OF CIGARETTE SMOKING BEHAVIOR

John Joseph Seltenreich III, M.A.
Western Michigan University, 1982

This study involved the application of a relatively new biofeedback training procedure known as twilight training to the treatment of cigarette smoking behavior. Twilight training is the facilitation of a state of low arousal, whereupon audio material designed to affect the health of the subject is presented. Two subjects received training, and the results showed no change in their frequency of smoking and no ability to enhance the twilight state with training. Although the amount of training received differed between the two subjects, there were no differences noted between them. Possible reasons for present results and probable changes for future research are discussed.
ACKNOWLEDGEMENTS

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John Joseph Seltenreich III

ii
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WESTERN MICHIGAN UNIVERSITY, M.A., 1982
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS ......................................................... ii

LIST OF TABLES ................................................................. iv

LIST OF FIGURES ................................................................. v

Chapter

1. INTRODUCTION ......................................................... 1

   Subliminal Stimulation .............................................. 2

   Sleep-Learning and Sleep Perception ....................... 4

   Suggestology ............................................................. 6

   Sensory Deprivation ................................................ 7

   Biofeedback and Twilight Training ......................... 8

   Cigarette Smoking Behavior .................................... 11

   Rationale ................................................................. 14

II. METHODS ................................................................. 15

   Subject Selection .................................................... 15

   Setting ........................................................................ 15

   Procedure ............................................................... 17

   Data Acquisition ..................................................... 20

III. RESULTS ................................................................. 25

IV. DISCUSSION ............................................................. 30

APPENDIX A - Change Messages Used in Twilight Training

   Experiment ............................................................... 37

BIBLIOGRAPHY .............................................................. 39

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LIST OF TABLES

Table

1  Percent Change in Daily Cigarette Smoking Determined from Pre-Treatment and Post-Treatment Self-Monitoring . . . . . . 26

2  Data Showing Session Dates, Change Message Tape Exposure, and Comparative Average Between Subjects . . . . . . 29
LIST OF FIGURES

Figure

1  Epoch at which the 40th Repetition of the Change Message Tape Occurred Along Sessions ........... 28
CHAPTER 1

INTRODUCTION

The primary purpose of this investigation is to test the effectiveness of a new clinical biofeedback procedure known as twilight training (TT). TT is the facilitation of a state of low arousal whereupon audio material designed to affect the health of the participant is presented. The achievement of this state of low arousal is assisted through the use of electroencephalographic biofeedback training and mild sensory deprivation techniques.

TT is seen as being applicable to a wide range of behaviors, especially those resistant to change. Cigarette smoking behavior is one such behavior that is particularly resistant to change. It is this stubborn behavior, then, that is the focus for testing the effectiveness of the TT procedure.

The use of TT with cigarette smoking behavior is in part an outgrowth of the newly developing field of behavioral medicine. Behavioral medicine involves the application of knowledge gained in the fields of the behavioral sciences to the concerns of medicine, health, and illness. The debilitating effects that smoking has on a person's health is well known. The main complications coming from this self-destructive behavior are heart and lung diseases; the most feared of which is lung cancer. The danger to a person's health who smokes may best be exemplified by the message on the label of a pack of cigarettes; "Warning: Surgeon General has determined that cigarette smoking is
dangerous to your health."

TT is a relatively new treatment modality. With little historical perspective of its own, one must look at the various fields it has emerged from to understand its rationale and application. Most of these fields are involved in the research of learning without consciousness or learning when a subject's normal level of arousal is altered (lessened). The fields included here are subliminal stimulation, hypnopedia, sleep perception, suggestology, sensory deprivation and biofeedback.

Subliminal Stimulation

The fact that events may be perceived below our level of awareness, and that these events may influence our behavior, is now generally accepted (Silverman, 1975; Trank, 1976). As early as 1919, Hollington demonstrated subliminal effects. Silverman, Martin, Ungaro and Mendelsohn (1978) successfully used subliminal stimulation (SS) as an adjunctive treatment to behavior modification of obese subjects. Silverman, Frank, and Dachinger (1974) substituted SS for relaxation training in a systematic desensitization experiment with subjects that had insect phobias. Emmelkamp and Straatman (1976) also achieved positive results using a similar clinical procedure with subjects that had snake phobia. Silverman, Ross, Adler, and Lustig (1978) showed that SS could effect the accuracy of dart-throwing in college males. A researcher named Bedker (Secret-Voices, 1979) is using audio SS to successfully reduce shoplifting in supermarkets and department stores.

Zenhausern, Ciaola, and Pompo (1973) and Zenhausern and Hansen

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(1974) have found an increase in visual illusory experiences with
the subliminal presentation of white noise. Hardy and Legge (1968),
using a cross-modal design, found that the subliminal presentation of
emotional stimuli in one sensory channel may decrease the sensitivity
to neutral words in another channel.

SS has been shown to have an effect on schizophrenia. Spiro
and Silverman (1969) used an aggressive subliminal stimulus which
resulted in increased pathology. While in other experiments (Silver­
man, Levinson, Mendelsohn, Ungaro & Bronstein, 1975; Silverman, 1975)
the presentation of a symbiotic merging fantasy phrase—"Mommy and I are
one"—reduced pathology. Silverman (1968, 1971) and Tyner, Lewis and
Lee (1978) both found that some stimuli were not effective when pre­
sented at supraliminal levels of awareness.

Palmatier and Bornstein (1980) used SS along with a behavioral
treatment program in the treatment of smokers. All subjects received
a behavioral treatment program aimed at smoking cessation. The sub­
jects were randomly assigned to either an experimental group or a con­
trol group. Both groups received SS. The experimental group received
the symbiotic merging fantasy statement, "Mommy and I are one," whereas
the control group received the neutral stimulus, "people are walking." An
analysis of a four and twelve week follow-up showed that the subli­
minaly exposed message differentially effected the post-treatment
smoking behavior of the experimental group.

Some of the parameters of SS have been investigated. Fisher and
Paul (1959) found that a supine position enhances SS, and Fiss (1966)
found that subjects who were the most relaxed, generally were more
responsive to SS. Sackeim, Packer, and Gur (1977) have found that the
hemisphericity and cognitive sets of the subject may affect SS. Prim­
ing, the supraliminal presentation of material thematically related
to the subliminal stimulus, has been shown to enhance SS (Fisher, 1975,
1976). Finally, the illumination level of the stimulus, has been found
to be an important stimulus characteristic (Paul & Fisher, 1959). The
closer the stimulus is to the threshold of perception, the less likely
such effects shall occur.

The research reported within the area of subliminal stimulation
is fairly rigorous. Many of the papers cited included multiple experi­
ments with all experiments having control groups. The experiments some­
times included up to a hundred subjects and were evaluated under double
blind conditions. Furthermore, the evaluations included both self­
report and task performance measures.

Sleep-Learning and Sleep Perception

Sleep-learning, or as it is sometimes called, hypnopedia, involves
the presentation of material, usually several times a night, to sub­
jects while they sleep. The goal is to either be able to recall the
material upon awakening or increase the efficiency of learning of
material presented later while the subject is conscious. Almost all
the sleep-learning experiments involve the audio presentation of mate­
rial.

LeShan (1942) in an early experiment played a message suggesting
finger nails taste bitter to twenty boys at a summer camp. He obtained
a cessation of fingernail biting in 40% of the subjects. Elliot (1947)
played a list of fifteen common three-lettered words to subjects when the subjects' electroencephalograph (EEG) showed no alpha pattern. The subjects, upon awakening, demonstrated some retention of the material. Leuba and Bateman (1952) tested a woman who successfully demonstrated she could repeat three songs that were played to her while she slept. Levinson (1968) demonstrated that patients who had been anesthetized during an operation were still able to recall the exact words that were spoken during an operation.

Some researchers have investigated factors that may influence sleep-learning. Sexton and Poling (1973) demonstrated how the outcome of a sleep-learning study may be influenced by the sleeper effect. The sleeper effect is where the material presented during sleep may not become accessible to the subject's conscious memory for twenty-four to forty-eight hours, or even longer. Hoskovek (1966) found sleep-learning to be enhanced when subjects were given a suggestive set to be able to easily remember the material about to be presented. Barber (1957) in a sleep-perception study found that suggestability increases during sleep. In another sleep-perception study, Lasager and Lasager (1973) found that there was a progressive blurring of perception from stage one and rapid eye movement sleep to sleep stages three and four.

The research cited in this section mainly involved controlled studies performed under double blind conditions. Only some of the studies included a large number of subjects and one study was a simple case report. The strength of this type of research was greatly enhanced when the sleep states of the subjects were defined with the use of an electroencephalograph.
Suggestology

Suggestology is a method developed by Dr. Lazanov (1978), in Bulgaria, for the teaching of foreign languages. Suggestology is related to the previously discussed topics of subliminal stimulation and sleep-perception, in that it, too, focuses on presenting material to be learned when the pupil is in a non-ordinary state of consciousness. Racle (1977) lists three principles that suggestology is based on: (a) joy, and the absence of tension, (b) oneness of the conscious and unconscious, and (c) suggestive interaction. These principles for learning are developed in the classroom through the creation of a suggestive atmosphere. The suggestive atmosphere is enhanced through the use of classical music, which can create an emotional environment that will stimulate the individual's capacity and increase receptiveness (Racle, 1978). Music is used in association with other recognized suggestive factors including prestige, and credibility of the teacher and teaching instruction, the confidence and willingness of the students, and the structuring of the course on both the conscious and unconscious levels. In Canada, where they have been using these techniques to teach French, pupils in a suggestopedic classroom for two months have obtained the equivalent of a fourth year college competency.

The information cited here is certainly not to be taken as proof of the effectiveness of suggestology. There is not much research available to evaluate its effectiveness. Most of the research in suggestology has yet to be translated into English. What little research there presently is involves no controls whatsoever. The field of suggestology
still leaves much to be desired.

Sensory Deprivation

Sensory deprivation research provides us with an interesting paradigm for bringing about organismic changes. Unlike subliminal stimulation and suggestology, where different sorts of stimuli are presented, sensory deprivation involves depriving the organism of pattern sensory input.

Robertson (1961) suggests that sensory deprivation may be both an etiological factor in the development of emotional disorders and also may sometimes act as a therapeutic agent in restoring emotional equilibrium. Gibby, Adams, and Carrera (1960) found that a tape was more influential on the group exposed to sensory deprivation than three different control groups. Adams, Robertson, and Cooper (1964) also found positive results in an experiment of similar design. Suedfeld (1969) found that sensory deprivation subjects showed an increase in susceptibility to external influences. Zubek (1969) found that in observing physiological changes associated with being in a sensory deprived condition there was an appearance of slow alpha waves and an abundance of theta activity, especially in the temporal region. Morgan and Bakan (1965) demonstrated that sensory deprivation effects were facilitated by the subject being in a reclined position.

The research cited in the area of sensory deprivation often used control groups and was double blind evaluated. However, the effects obtained in sensory deprivation conditions seem often weak and transitory. The extent that sensory deprivation alone can enhance a person's
susceptibility to making any sort of profound change in cognition or behavior remains to be demonstrated.

Biocfeedback and Twilight Training

As previously stated, Twilight Training (TT) is the facilitation of a state of low arousal, whereupon audio material designed to affect the health of the participant is presented. This state of low arousal is defined in terms of EEG activity as being between 4-7 hertz. The name associated with this frequency is theta. Many researchers (Brown, 1969, 1970; Klug & Brown, 1974) began demonstrating that with the aid of biofeedback, feedback to a subject of information concerning his or her own physiological process, the abundance of theta density could be increased. Sittenfeld, Budzynsky and Stoyva (1976) demonstrated the use of shaping could enhance the training of theta activity. Finally, Peper and Ancoli (1977) showed that theta rhythms are associated with a non-critical processing of information.

Budzynski (1972, 1976, 1977; Budzynski & Peffer, 1974) is the inventor of the TT procedure. His technique involves the monitoring of the EEG activity of the subject. While the subject is above the EEG criteria for the presentation of the change messages, another recorded message is played suggesting the subject relax, to become drowsy, to learn, and remember the material to be presented. When the subject's brain rhythms fall within the band width criteria desired for TT, the relaxation suggestion discontinues and the change messages are presented. During the entire training procedure music is played. Budzynsky orginally used pink noise to mask background noise, thus creating a
a mild sensory deprivation condition. Budzynski now uses music instead of pink noise, in that it may help the subject with the assimilation of the verbal material while in a twilight state, as well as effectively masking background noise.

The EEG bandwidth used by Budzynski for defining the twilight state includes low frequency alpha along with theta frequencies. These low alpha frequencies are also associated with the transitory twilight state. Since the twilight state is so transitory, and most people pass quickly through it into deeper levels of sleep, Budzynski uses what he calls a bumping device. This device increases the volume of the change messages as the EEG frequency decreases. This increases the arousal level of the subject, thus bumping the subject back towards a higher frequency in the twilight state.

Budzynski also screens his subjects for high frontal electromyographic (EMG) levels. What he has found out is that subjects with high levels of frontal EMG activity present do not show much theta density and make poor EEG biofeedback training subjects. When one such person is identified the subject is given a few EMG frontal biofeedback training sessions. When the subject is able to lower the frontal tension level, TT is begun.

Budzynski uses TT as a short term intensive therapeutic procedure. He has reported success in only five sessions with assertion messages designed for a client who had been unable to become more assertive while in traditional therapy for three years. The client eventually was able to ask a woman, whom he worked with, out for dinner. Before treatment he had been unable to speak to her. Budzynski has also found its
short term effectiveness in a case involving anxiety, guilt, insomnia, and problem drinking resulting from a divorce. The subject was able to reduce his anxiety and guilt about the role he played in precipitating the divorce. The subject was also able to eliminate his insomnia as well as reduce his dependence on drinking as a way of coping.

Havelick (1977) used a variation of TT as a part of a treatment protocol. The patient had several presenting complaints, including migraine headaches, valium dependency, and cigarette smoking. Havelick used EMG biofeedback training and temperature training to control drug dependency and migraine. He then instituted a TT procedure for smoking where he used change messages that suggested the patient could see himself working without smoking, and also emphasizing how much better the patient would feel from not needing or using cigarettes. Havelick was successful in extinguishing the cigarette smoking. The TT procedure used here was a much simpler technique than used by Budzynski. What Havelick used as a criteria for a twilight state was the doubling of baseline alpha as defined by an EEG. Also Havelick did not use music or any other suggestive technique, and the subject was aware of the change messages. It was effective, however, and suggests further research in the area of TT and cigarette smoking may be fruitful.

The literature reported on TT, although promising, leaves much to be desired. So far the level of research remains at that of case-report and nowhere is there any control groups or any double blind evaluations. There is not even any pre- or post- treatment evaluations. Certainly no conclusions can be reached about the effectiveness of TT until further research can be done.
Cigarette Smoking Behavior

Cigarette smoking is without a doubt a serious health hazard (Boudewyns, 1977). Male cigarette smokers are eleven times as likely to die of lung cancer as non-smokers. They are also six times as likely to die of emphysema. Cigarette smoking also increases the risk of heart disease.

Boudewyns posits many reasons why smoking is such a difficult behavior to extinguish. First of all, cigarette smoking leads to a mild addiction. It also is a strong and durable habit in that it has occurred for many trials and this occurrence has generalized over a wide range of conditions. Furthermore, cigarette smoking is a difficult habit to eliminate in that its immediate effects are reinforcing; whereas the debilitating consequences produced from smoking are long range. Finally, smoking is also reported by users as a tension reducer.

Bernstein (1969) reviews many attempts at modifying smoking behavior. He states that through legislative action, advertising campaigns, clinics which may or may not employ medication, and anti-smoking drugs, there has been, here-to-date, limited effectiveness.

Schmal, Lichenstein, and Harris (1972) found some success using an aversive conditioning technique. The experimenters used two groups; one which received warm smoky air while rapidly smoking; while the other received warm mentholated air while rapidly smoking. The rapid smoking condition required the subjects to take one normal inhalation every six seconds. Trials were terminated whenever the subjects could not tolerate another inhalation. The subjects would then repeat the auto-suggestive phrase, "I don't want to smoke anymore," while they
crushed out their cigarette. Subjects were then asked to evaluate the effects of smoking, and were verbally reinforced by the experimenter for any verbal response that emphasized cigarette smoking's harmful qualities. Additional trials were then continued until the subjects felt threatened by the onset of serious physical reactions to the over-smoking technique. The session would then be ended. The average number of sessions was eight. Subjects were asked not to smoke between sessions as it would have diluted the effectiveness of the training session. Also, subjects were allowed to come in for booster sessions during the following six months if they believed they needed further training to remain abstinent. The subjects were also given considerable expectation of success of the treatment before the sessions began. The researchers found no difference between the groups, and an average abstinence rate of 68% was obtained at a six-month follow-up.

Lichenstein, Harris, Birchler, Wahl, and Schmal (1973) performed a similar study to the one mentioned above. They compared groups receiving rapid smoking, plus warm smoking air, rapid smoking only, warm smokey air only, and an attention placebo group. The experimental groups differed significantly from the control 'attention placebo' group, but they did not differ among each other. The overall cessation rate for the three experimental groups at a six-month follow-up was 38%.

A very interesting investigation into the parameters of cigarette behavior was carried out by Mausner (1973). Mausner was looking for differences among smokers, exsmokers, and non-smokers. What he found was that there was no difference among these groups in their attitudes concerning the disadvantages of smoking. All groups were equally aware
of the ill effects smoking may have on one's health. The differences appeared among the groups in their attitudes towards the benefits from quitting smoking. Whereas the smoker's group perceived no benefit from stopping, both the exsmokers and non-smokers perceived a greater "subjective expected utility" in stopping smoking. What Mausner was implying was that the latter two groups expected some benefits to them personally from quitting smoking. Mausner compared this finding to the focus of most advertising campaigns against smoking where only the ill effects are presented. The focusing on only the ill effects is also part of the rapid smoking technique.

Besides the differences related to expected subjective utility, Mausner found that smokers who expected they would have difficulty in managing tension when they quit smoking were unlikely to be successful at their attempts. He recommends that a tension reduction exercise be taught. Mausner also suggested that the teaching of smokers to fantasize their successfully not smoking would be of benefit. This would seem as though there would be a great benefit from a TT procedure that would use change messages. TT could instill a greater sense of expected subjective utility in their subjects while emphasizing the successful stopping of smoking. This is very similar to the format of change messages reported earlier by Havelick (1977).

The smoking research cited above involved double blind evaluations as well as control groups. However, as the studies often involved multiple experimental groups and there was little difference in change among them, there seems to be some confusion as to the effectiveness of the experimental procedures. Either they are all equally effective or
there is some confounding variable that remains unidentified.

Rationale

Twilight training as a treatment approach to cigarette smoking behavior was chosen for several reasons. First, both subliminal perception and twilight training have been demonstrated to affect cigarette smoking behavior. Twilight training has the advantage over other methods of learning where consciousness is altered, in that it offers state specific learning. That is to say, the experimenter can physiologically define parameters of the subject at which exposure to the stimulus occurs. Finally, twilight training has some possible added advantages over other cigarette smoking treatment programs that are aversive. An example of this may be that in procedures employing rapid smoking, people with already existing heart or lung disabilities may not be able to participate. Also, there may be some people who are unwilling to submit themselves to any aversive procedure, whatsoever.

Although TT has been demonstrated to affect cigarette smoking, this has been on the level of a case study only. No experimental research demonstrates the effectiveness of TT. It is the purpose of this study through its implementation of a single case experimental design to begin building a foundation of research on the subject of TT. More specifically, the hypothesis of this study is that the use of TT will result in the reduction of cigarette smoking.
CHAPTER II

METHODS

Subject Selection

The subjects consisted of one 28 year old female and one 29 year old male. Both were Caucasians. The subjects, both of whom were friends of the experimenter, volunteered to participate in the study upon hearing a general explanation of the intent of the research.

The subjects were free of medication and had no present medical problems. Both were asked not to consume any alcohol or caffeine three hours prior to their sessions. It was explained to them that these substances would affect central nervous system responding and thus alter physiological recording. As the subjects were acquaintances, they were asked not to communicate with one another as to their involvement in this research.

Setting

The experiment was conducted at the Institute for Holistic Medicine, an outpatient facility on the grounds of Borgess Medical Center. The Institute is a joint project of Western Michigan University and Borgess Medical Center. The Institute is located in a refurbished house which accommodates four offices, three individual therapy rooms, an equipment room and a multi-purpose group therapy and waiting room. Data collection occurred during the morning and afternoon and was integrated into the daily activities of the Institute as part of the
normal routine.

The therapy room used in the experiment was carpeted and approximately 15 X 9 feet. The room contained a reclining chair in which the subject sat and another chair where the experimenter could sit if he wished to talk to the subject before or after training. Also, contained in the room was a portable cart which was used to store preparation supplies for biofeedback training. There was a small cabinet in the room. On top of the cabinet were several biofeedback devices and housed inside the cabinet were four physiological amplifiers that were wired underneath the floor, through the basement, to the adjacent equipment room. Leads from the amplifiers exited out the cabinet and were kept neatly coiled on a wall rack. Also on the wall were two paintings that gave the room a homey atmosphere. The room had overhead flourescent lamps that were only lit during subject preparation. The rest of the time the room was softly illuminated by a floor lamp. The only window in the room was enclosed by shutters to screen out incoming light.

There were three doors in the therapy room. One door led to another therapy room and another door led to the waiting room. Both of these doors were not used. A third door led out into the equipment room and it was through this door that the subjects entered and exited.

The 4 X 10 foot equipment room that was adjacent to the therapy room was where the experimenter sat during training. The room contained a large rack of modular biofeedback equipment that controlled physiological recordings and feedback. Also, in the room was a computer and audio equipment. This room was lit with an overhead
flourescent lamp that was only used while programming the equipment. The rest of the time the room was dimly lit by a small overhead studio spotlight. There were three doors also in this room. One door that led to the second therapy room was not used. Of the other two doors, one led out to a rear entry way in the building and the other as previously mentioned led to the therapy room used in this experiment. In the door that led from the equipment room to the therapy room is a two-way mirror where the experimenter could observe the subjects that were in training. In all sessions the subjects passed through the equipment room before and after each session.

Procedure

This study implemented a single case experimental design with one replication.

The dependent variable was cigarette smoking and the independent variable was twilight training; that is, exposure to a tape of change messages while in a state of physiological low arousal characterized by increased theta brain wave activity.

The study, itself, can be divided up into three distinct stages. First came the initial contact session which includes the pretreatment baseline measurement of cigarette smoking. Next came the training sessions. Last came the post-treatment baseline.

The initial contact session focused on all preliminary work that was needed to be done before training could begin. Both of the subjects were interviewed individually.

The first matter that was addressed was the general explanation
of the training procedure. The subjects were encouraged to ask questions about the study until they felt they understood it. This was followed by a signing of the informed consent agreement.

The next issue addressed was the determining of the subjective expected utility (Mausner, 1973) from quitting smoking. This was performed in a direct questioning procedure that was initiated with the question "What do you expect to gain by quitting smoking?" The experimenter prompted the subjects to focus on the benefits of stopping smoking and not on the negative effects of smoking. Each subject came up with four sentences. These were recorded along with a fifth phrase, "Mommy and I are one" (symbiotic merging fantasy) on a TDK endless cassette (see Appendix A).

A third consideration addressed at the initial contact session was the self-monitoring procedure to be used to determine the pre-training baseline of cigarettes smoking. The subjects were each given a wrist counter and were instructed in its use. They were to advance the counter once for each cigarette they smoked during the course of a day. At the end of the day they were to record the total number of cigarettes smoked along with the data on a 3 X 5 card. They would then reset the counter for the following day. The subjects were to record the data for five days. It was explained that this must be done before training could begin.

Following the instructions on self-monitoring, the subjects were asked if they expected to have difficulty managing tension when they quit smoking. Mausner (1973) has shown that smokers who foresee this difficulty will have a hard time quitting smoking unless they are given the aid of a tension reducing device. The subjects were offered
the opportunity to listen to a cassette tape designed to induce relaxation. However, neither of them reported that managing tension would be of any difficulty and they both declined the use of the tape.

Finally in the initial contact session subjects were monitored for resting electromyograph (EMG) levels from the frontalis muscle. Budzynski (1972) observed that subjects with high levels of frontal EMG produce little theta brainwave activity during twilight training. This changes when the subjects with high frontal levels are first given frontal EMG feedback training to lower the level to below three microvolts. In this experiment, both subjects were below the three microvolt level at the end of a two minute rest period thus negating the need for EMG biofeedback training. During the training procedure each subject received nine sessions. For a session to count the subject had to receive at least 40 exposures of the entire 20 second tape. This is to control for a situation wherein a subject may not be able to relax and thus receives little or no exposure to the change messages. As was the case, however, both subjects were able to meet the training criteria for every session they attended.

When training, the subjects were seated in a recliner lounge chair in the therapy room. The chair was fully reclined. The subjects wore a black cloth eye mask that served to block out all visual stimulation. They also wore stereo head phones which enabled them to listen to classical music during training. The record used during training was Bach, Suite No. 3, performed by Segovia with the Symphony of the Air. The change messages also were played through the headphones. Finally, the headphones allowed for the experimenter to communicate with the
subjects. This last function enabled the experimenter to tell the subjects when a session was over. The cassette could be heard along with the music but the microphone used by the experimenter preempted other audio channels when used.

During training the experimenter sat in the equipment room and monitored the equipment. The experimenter also monitored the subjects periodically by looking through the two-way mirror located in the door that opened from the equipment room to the therapy room.

Following the last training session the subjects were asked about the frequency of their smoking. In each case the subjects replied that they were still smoking. They were then asked again to monitor their smoking behavior. They used the same procedure in the post-treatment assessment. The experimenter offered to provide the subjects with additional training sessions if they desired. Neither asked for any, however.

Data Acquisition

All the biomedical instrumentation used in this project was manufactured by Med Associates Incorporated. The postal address for Med Associates is Box 47, East Farfield, VT, 05448.

The electromyographic (EMG) baseline levels were monitored on the frontalis muscles located across the forehead. EMG activity was detected with the use of skin surface electrodes (Beckman silver-silver chloride) attached at standard locations. The electrodes were attached to the forehead with double-sided adhesive disks. The recording site required an active and referent electrode with a ground electrode placed an equal distance between them. Beckman electrode paste was
was used to fill the electrode cup which further enhanced signal conductivity. A criteria of 5,000 ohms was set for which the impedance must have been below before recording could begin.

The raw EMG signal received a gain of 10,000 to minimize signal loss while traveling from the therapy room to the equipment room. From there the signal was filtered to use the range between 90 - 1,000 hertz. This decreased the chance of cardiac artifact. The analogue signal was then converted to digital impulses where it was then collected in a computer at 100 second epochs. The computer would then give an average of EMG amplitude in microvolts which was recorded by a digital strip recorder printer.

The recording of EEG activity during twilight training (TT) used a monopolar recording procedure with the active electrode placed at 0\(^{\circ}\) (according to the 10-20 system for electrode placement). The referent electrode was attached to the left earlobe while the ground electrode was attached to the right earlobe. The electrodes used were miniature gold electrodes manufactured by Beckman. The active electrode was attached with collodium and the other two electrodes were mounted in spring-loaded earclips for easy clip-on attachment. For all electrodes, Beckman electrode paste was used. The raw EEG signal then received a gain of 10,000 by the pre-amplifier. The signal was then directed to the equipment room where it was manipulated in several ways.

Recorded during TT was electroencephalographic (EEG) amplitude of theta activity, the average frequency of theta activity and the per cent time each subject was defined to be in the twilight state.

Recording of theta amplitude involved taking the raw EEG signal,
once it was in the equipment room, and filtering out everything except 4 to 8 hertz activity. The analogue signal was then converted to digital units. The signal then traveled to a computer that read out an average amplitude every 100 seconds and was recorded on a digital strip recorder.

Recording of the average frequency was done by taking the filtered EEG signal (theta) and running it through a frequency to voltage converter. The analogue signal was then converted to a digital signal. A computer then measured the signal and gave a digital read out of average frequency every 100 seconds. This also was recorded on a digital strip recorder.

The recording of percent time in the twilight state involved the use of two signals; a theta amplitude and a theta frequency. The amplitude signal was derived by taking the raw EEG signal and filtering out all the electrical activity except from 4 to 8 hertz. The signal was then integrated with a time constant of .5 seconds. The signal then led into a threshold comparator that was set at 10 microvolts. If the filtered signal was above 10 microvolts, a non-analogue logic one signal would be generated that tripped one gate in an and gate module. The use of the comparator here was to filter out all low amplitude artifact.

The theta frequency signal was derived by taking the raw EEG signal and filtering all but 4 to 8 hertz activity. This signal was then altered in a frequency to voltage converter and traveled from there to a threshold comparator. The threshold comparator was set in such a way that it would narrow the range of frequency from 4 to 8 hertz to 4 to 7
hertz. This frequency clipping further eliminates artifact that may result from the flooding of filters from higher frequency, high amplitude signals. From the comparator the signal traveled to the same and gate as in the case of the theta amplitude. When both the amplitude and frequency criteria are met, the output on the and gate enables the computer to accumulate tenths of a second pulses over 100 second epochs. The number of seconds accumulated divided by a complete epoch, gives the percent time read out.

The output on the and gate also served another function. When both the amplitude and frequency criteria are met the output of the and gate closes a relay that powers the tape recorder. That is, the tape recorder turns on whenever a subject is in the defined physiological state.

The volume of the cassette recordings was modified by a voltage amplifier (VCA). The VCA would increase or decrease the volume of the recordings as the voltage that powered it would increase or decrease. The signal that powered it came from mixture of two signals; a delta amplitude signal and an inverted theta frequency signal. These signals were mixed in an analogue mixer and were reduced to 50% of their power.

The theta signal above was inverted so that as the subject's theta frequency decreased, designating movement towards sleep, the signal would increase in power. The increase in power would increase the volume of the message, arousing (bumping) the subject back into the twilight state. The scaling amplifier had to be used with the inverted signal so that the theta could decrease but still remain in a positive range.
The delta amplitude signal was used in that the decreasing (inverted) theta frequency signal was not of sufficient power to effectively increase the volume of the VCA. However, as high amplitude delta waves begin appearing as a subject descends further into sleep, this signal was used to further power the VCA. This would then provide sufficient power to ensure bumping. In fact the combination of the theta frequency and delta amplitude signals provided so much power the VCA would reach maximum volume too quickly. To control for this the signals were used at one-half their power.

Finally, the subject was fitted with a set of Pioneer headphones. This enabled the subject to hear the cassette, music and messages from the experimenter.
CHAPTER III

RESULTS

It was the purpose of this investigation to see whether or not change messages, played to a subject while in a state of low arousal (twilight state), could alter cigarette smoking behavior. The results clearly show no change occurred.

Table 1 shows the results of pre-training and post-training monitoring of cigarette smoking by Subjects 1 and 2. Subject 1 showed only a decrease in 3.2% of the cigarettes smoked daily. In terms of actual cigarettes smoked, this represents a daily decrease of 2 cigarettes. Subject 2 showed an increase of 10.5% cigarettes smoked daily. Though this may seem like a large increase in the frequency of smoking behavior, the actual number of cigarettes smoked was small and this change represented an increase in less than one-half cigarette per day. Percent daily changes of both subjects demonstrate no remarkable benefits from having participated in this study.

Though there was no reduction demonstrated in clinical terms with respect to cigarette smoking, the subjects may have demonstrated they were effected by TT in another way. As with all biofeedback training procedures it has been demonstrated that with an increase in exposure to the feedback stimulus, the subject will be able to meet the physiological requirements for feedback in less time. More specifically, in this study this would result in a decrease in the number of epochs of training required during a session to reach the acceptable session
Table 1
Percent Change in Daily Cigarette Smoking Determined from Pre-Treatment and Post-Treatment Self-Monitoring

<table>
<thead>
<tr>
<th>Subject 1</th>
<th>Day</th>
<th>Pre No.</th>
<th>Post No.</th>
<th>% Daily Change*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>59</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>61</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>60</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>63</td>
<td>60</td>
<td></td>
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<td></td>
<td>5</td>
<td>67</td>
<td>58</td>
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<td></td>
<td>Average</td>
<td>62</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-3.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject 2</th>
<th>Day</th>
<th>Pre No.</th>
<th>Post No.</th>
<th>% Daily Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
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<td>4</td>
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<td>4</td>
<td>5</td>
<td>5</td>
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<tr>
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<td>5</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td>3.8</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+10.5</td>
</tr>
</tbody>
</table>

*A positive or negative sign indicates either an increase or decrease respectively in number of cigarettes smoked.
training criteria of forty tape repetitions. Figure 1 plots along epochs on the 40th repetition of the tape for each session. Both subjects demonstrate considerable variation among sessions, however, no clear trend for either subject is evident.

In Table 2, other various parameters of training are presented. Although the criterion epoch, where the 40th repetition of the tape occurred was used to sanction a session, training often went beyond that epoch. As Table 2 demonstrates, Subject 1 on the average received almost 50% more training time as well as almost 50% more exposure to the training tape. However, the mean average occurrence of the criterion epoch was nearly the same for both subjects.

Finally, Table 2 also shows the dates that the training sessions occurred. The time between sessions may be seen as a form of intensity with which the stimulus was presented.
Figure 1

Epoch at which the 40th Repetition of the Change Message Tape Occurred Along Sessions
Table 2
Data Showing Session Dates, Change Message Tape Exposure, and Comparative Average Between Subjects

<table>
<thead>
<tr>
<th>Date</th>
<th>Criterion Epoch</th>
<th>Total # of Epochs</th>
<th>Total Repetition of Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-13-80</td>
<td>22</td>
<td>22</td>
<td>56.5</td>
</tr>
<tr>
<td>10-15-80</td>
<td>16</td>
<td>38</td>
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<td>10-20-80</td>
<td>24</td>
<td>25</td>
<td>44.7</td>
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<tr>
<td>10-22-80</td>
<td>21</td>
<td>28</td>
<td>71.4</td>
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<td>10-27-80</td>
<td>18</td>
<td>38</td>
<td>90.3</td>
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<td>10-29-80</td>
<td>19</td>
<td>26</td>
<td>62.9</td>
</tr>
<tr>
<td>2-19-81</td>
<td>12</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>2-25-81</td>
<td>12</td>
<td>25</td>
<td>98.5</td>
</tr>
<tr>
<td>3-10-81</td>
<td>17</td>
<td>18</td>
<td>46.1</td>
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<tr>
<td><strong>Average</strong></td>
<td><strong>17.9</strong></td>
<td><strong>27.8</strong></td>
<td><strong>74.7</strong></td>
</tr>
<tr>
<td><strong>Subject 2</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>12-16-80</td>
<td>17</td>
<td>19</td>
<td>58.6</td>
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<td>12-18-80</td>
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<td>1-8-81</td>
<td>15</td>
<td>21</td>
<td>68.6</td>
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<tr>
<td>1-22-81</td>
<td>17</td>
<td>18</td>
<td>47.3</td>
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<tr>
<td>1-27-81</td>
<td>19</td>
<td>19</td>
<td>44.5</td>
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<tr>
<td>1-29-81</td>
<td>23</td>
<td>23</td>
<td>41.2</td>
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<tr>
<td>2-17-81</td>
<td>21</td>
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<td>2-19-81</td>
<td>14</td>
<td>19</td>
<td>63.2</td>
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<tr>
<td><strong>Average</strong></td>
<td><strong>17</strong></td>
<td><strong>19.8</strong></td>
<td><strong>56.4</strong></td>
</tr>
</tbody>
</table>
CHAPTER IV

DISCUSSION

The results show that no significant decrease in cigarette smoking behavior occurred. Therefore, the hypothesis that the use of TT will result in the reduction of cigarette smoking is not supported. Also shown is that neither Subject 1 nor Subject 2 were able to enhance their training by facilitating increased exposure to the change messages. However, both subjects were able to meet the training criteria from the onset of the first training session. Finally, although Subject 1 received almost an additional 50% more training than Subject 2, there is little difference in results between the two.

Upon comparing the above results with research previously mentioned, there are some differences worth mentioning. One consideration is that the tapes used in this study were made by the subjects. In exploratory research performed in our laboratory, the subjects have reported benefiting from the greater sense of involvement they experienced from making their own tapes. However, this differs in procedure from Havelick (1977), Budzynski (1972, 1976, 1977) and Budzynski and Peffer (1974), where the experimenter obtained relevant information from their subjects and then proceeded to make tapes for the subjects. This research may also be seen in contrast with work done in the area of subliminal stimulation (Silverman, 1968, 1971; Tyner, Lewis & Lee, 1978; Paul & Fisher, 1959) where some stimuli were not effective when presented at supraliminal levels of awareness. Of interest to this point is that although
the subjects knew what was on the tapes, they sometimes could not report what they heard during training even though they could recall having heard something.

Another consideration with respect to the research reviewed is how might the sleeper effect found by Sexton and Poling (1973) enter into the present results. It may be that deep seated behavioral and cognitive patterns, such as that represented by smoking, may take a long time to be uprooted and replaced by a new set of patterns.

There are several possible reasons why this study failed to demonstrate the effectiveness of this type of training in effecting cigarette smoking cessation. The most obvious may simply be that twilight training is not effective. However, such a conclusion may be premature.

For example, one cannot rule out the role played by equipment difficulties. An instance of this is with the bumping device which served to arouse the subjects when they began to drift into deeper states of sleep.

The module used in this was the voltage controlled amplifier which would increase the volume of the change messages as sleep stages deepened (see procedure section for further explanation of equipment operation). This experimenter noticed that as the change messages became louder, the messages would distort by becoming broken and garbled.

Also, when any distortion occurred, the loudness of the messages ceased increasing which limited the bumping effectiveness. This became evident with the termination of a training session when the subjects sometimes needed several verbal promptings by the experimenter to take a deep breath and stretch. They may have fallen asleep.
The module was sent back to the manufacturer for repairs which disrupted training for a few weeks. The module was returned 3 weeks later with the manufacturer explaining that nothing could be found wrong with it. It was suggested that the module might be returned at a later date, where an additional one watt amplifier could be included which would increase its loudness capacity while limiting its distortion.

Another equipment problem centered around the theta filter used to designate when the subject was in a twilight state. This filter seemed to become activated while the subject was still in a conscious state. Why this happened is not totally clear but the best analysis is that the low frequency, high amplitude alpha signals, which are present before theta activity becomes more dominant, may be of sufficient strength to flood the 5-pole butterworth filters used in the modules. Frequency clipping resolved some of this difficulty, but a better solution for future use may involve the use of a wider spectrum filter from .5 to 40 hertz. This filter would still allow for frequency clipping to designate when theta was present, but it would also have the added advantage of being able to register what is the predominant frequency present at any one time and not just when there is some activity present, as is the case at all times when using the smaller band width filters.

Like the problems with the equipment there also were problems with the subjects. Subject 1 found considerable difficulty in making any of the Friday appointments. Also, after training had begun this subject was assigned to a work detail by his employer which involved his working fourteen hours a day for several weeks. As Table 2 shows, there is
a rather large gap in attendance beginning after 10-29-80. Part of this gap is due to the work situation of Subject 1, however, when the work schedule returned to normal, there was still a lengthy delay before the subject returned to training. Attendance after the return was rather inconsistent.

Subject 2 also had some difficulty with attendance. The difficulty mostly centered around the fact that on two separate occasions this subject became involved in auto accidents that resulted in the loss of her automobile for repairs. This subject had the option of riding the bus lines to training but chose not to do so.

The difficulty associated with attendance remains unclear. Several factors may be involved. One factor may be that the training procedure is aversive. Another reason may be that the subjects were poorly motivated. A third reason may be that smoking cessation has resistances which were not sufficiently addressed in this study. The automobile difficulty experienced by Subject 2 was both times at-fault accidents by the subject. This may simply be bad luck which sometimes occurs with driving in hazardous Michigan winter weather, but it may also be a form of acting out one's feelings. Any experimenter using a TT procedure should be aware of this possibility. As this experiment was not designed to assess the subjective experience of the subjects, the attendance difficulty remains a mystery. Future research might involve letting the subjects give their personal experiences associated with being involved in this type of research.

Another change that might be helpful could be to develop some contingencies which may help assure the subject's attendance. The use of
any contingency which may prevent a subject from dropping out is unethical, of course, and should not be used with an experimental procedure. However, a contingency which presents some sort of reward for participation may be facilitative. The incentive involved would be individualized for each subject and could be worked out in an initial interview and drawn up in a contract.

Other changes for future research may be labeled as design or procedural considerations. As mentioned above, there could be a change with attendance or the scheduling of sessions. This experiment was initially designed with the intention of having three training sessions a week for three weeks. Although initially agreeing to this schedule, it soon became evident that the subjects could not meet this criterion. Scheduling changes that could be made should insure an intensity of sessions. If three sessions a week could not be made, then two sessions a week could be used. The idea in twilight training is that intensive training sessions will enhance the greatest change. The other dimension of scheduling which focuses on the total number of sessions may also be changed. Nine was chosen in this experiment as being representative of short term training. This is not based on any empirical observation, however. A study in the future may compare identical procedures that run for different lengths of time. Cigarette smoking was chosen in this study due to its label as a particularly difficult behavior to change. It may be that such a behavior would take many more sessions than used here.

Maybe the most important consideration for future training sessions is to combine twilight training with other known effective treatment
procedures. Perhaps TT is useful primarily in modifying generalized self-images. These can be built up and maintained at states of awareness not as accessible to modification as the more superficial habit pattern of cigarette smoking. It may be that for smoking cessation to be successful, the cognitive self image of being a smoker will have to be confronted and altered. Although change in such an image may be necessary and pre-requisite to cessation it may have to be coupled with a program of behavioral intervention. Twilight training is not an exclusive procedure and need not remain isolated. Its purpose as used in this experiment is to facilitate the subjective expected utility of the participants which will aid in their quitting smoking. This approach could be combined with procedures which aid in the withdrawal from the physical addiction associated with nicotine use. Also, the addition of a support group of people who are also quitting may be helpful.

A different experimental design than the one used in this study may clarify this point. The design would make use of three experimental groups. The first group would receive TT only. The second would receive a behavioral treatment program only. And the third group would receive a combined TT and behavioral treatment program. If the third group's cessation were significantly greater than either of the first two, then an analysis of the data may delineate out the differential treatment effects of both TT and the behavioral program.

Finally, this discussion can be concluded with an anecdote regarding the effectiveness of twilight training with Subject 2. It became clear during the initial interview with this subject that her smoking pattern consisted of smoking a few cigarettes late each night after work. The
subject only smoked while alone. The subject reported being bored and lonely at night and that smoking gave her something to do. This subject had moved to Kalamazoo within the past few months and had not yet created much of a support group for herself. She enjoyed going out on dates but had not been out on any since she had moved. She was not the adventuresome type who might go out alone to meet people, as she felt it was inappropriate for a woman to go out alone.

With further discussion, she vocalized how she knew her smoking was related to her loneliness and that only she could do something about it. The subject and the experimenter decided to orient the change messages towards being more assertive.

As time passed, Subject 2 came in and reported that she had met a man recently and that she had taken steps to cultivate his friendship. These steps included calling him and inviting him over for dinner. This act she believed was a giant step forward for her in being more assertive. She felt satisfaction in the relationship and reported no longer feeling as bored or unhappy.

Whether this change in her behavior is related to the twilight training, or a conscious effort on this subject's behalf to change, it is impossible to say. Although she became more assertive, her cigarette smoking remained the same. Upon inquiring about her present smoking behavior, she reported that her new found friend was also a smoker and that when she would get together with him late in the evening after work, they would smoke a few cigarettes together.
APPENDIX A

CHANGE MESSAGES USED IN TWILIGHT TRAINING EXPERIMENT
SUBJECT 1

I feel better as I smoke less.
I feel more in control as I smoke less.
I feel satisfied and free from smoking.
My stamina increases as my smoking decreases.
Mommy and I are one.

SUBJECT 2

I respect myself.
I feel healthier when I don't smoke.
I love myself.
Take a chance.
I can enjoy life.
Mommy and I are one.
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