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THE EFFECTS OF UNCONTROLLABLE TASK OUTCOMES ON ELECTROMYOGRAPHICALLY MEASURED TRANSIENT FACIAL EXPRESSION

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ABSTRACT

THE EFFECTS OF UNCONTROLLABLE TASK OUTCOMES
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The purpose of this study was to explore for the occurrence of transient changes of facial expression during learned helplessness conditions. To test for the effects of learned helplessness on facial expression, two groups of subjects were treated with a series of uncontrollable or controllable stimuli. One group of subjects could not escape a repeated presentation of a loud tone (no-escape/learned helpless group); the other (escape group) could. After treatment with the tone, both groups were given the task of trying to solve 20 single-solution anagrams. During the anagram-solving task, subjects were monitored for facial behavior.

Hypotheses were tested regarding the effect of treatment with escapable and inescapable tones upon facial expression emitted during the subsequent anagrams task. The dependent variables were based on electromyogram recordings from four surface facial sites: the

frontalis, mentalis, masseter, and depressor facial muscles. The measures derived from the electromyograms were: (a) number of changes of facial expression (facial lability); (b) number of repeated facial changes; (c) number of categories of expressions exhibited, and (d) average duration of an expression. The data were analyzed in two trial blocks of 10 anagram trials each. The null hypotheses were tested using univariate analysis of variance with a 5% rejection region chosen for all univariate tests. Analyses revealed that the inescapable group exhibited a significantly greater number of changes of facial expression and repeated facial changes during the first 10 anagram trials. No significant differences were found during the first trial block for number of categories of patterns displayed nor for average duration of expression. During the second trial block, no significant differences were found between the treatment groups on any of the facial measures.

There were no significant main effects for trial block and only one significant trial block-treatment interaction effect; that was for repeated facial changes.

Additional univariate analyses of variance were performed to determine if treatment had an effect on subsequent anagram task-solving behaviors. No significant differences were found between the treatment groups on the four anagram-solving variables. They were: mean

response time for correct solution, number of correct solutions, number of incorrect solutions, and number of TIME UP trials.

Based on the results of the study, three general conclusions were made: (1) EMG measures of facial changes were found capable of discriminating between the facial activity of the treatment groups, suggesting that facial EMG may be a useful tool in the quantifying of compacted affect behavior; (2) the facial change findings tend to support the predictions based on compacted affect theory, suggesting that levels of compacting are related to previous painful experiences; and (3) the lack of behavioral differences found on the anagram-solving measures calls into question the helplessness induction procedures used in this study and more importantly the assumptions underlying the helplessness-inducing theory itself.

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

CHAPTER I

THE PROBLEM

Introduction

Since S. Freud's (1894) early definition of psychological "defense" as the struggle against painful or unendurable ideas and affects, psychotherapeutic concern for client affects and their related defenses has been constant. The repeated use of distorted emotional behavior is variously seen as a symptom, cause, or attribute of psychological maladjustment. Anna Freud (1937) noted that for defenses to occur, the affects "must submit to all the various measures to which the ego resorts in its efforts to master them, i.e., they must undergo metamorphosis" (p. 34).

Tomkins (1962) uses the term "affect transformation" to describe this metamorphosis. Tomkins (1962, 1963) and others (Kell & Mueller, 1966; Jacobson, 1967; Haggard & Isaacs, 1966; Hinds, 1976) have noted transformations on the faces of clients which miniaturize and combine affect to form a part of the clients' defenses. The nature of the transformation is the compressing and combining of single affects over very short (two seconds

or less) time spans. Kell and Mueller (1966) termed this compressing and combining of affect "compacted affect." The dynamics of compacted affect relate to the temporal reduction of the experience of one affect by the expression of another. The purpose of this transformation is the termination or avoidance of unwanted affect. Kell and Mueller (1966) believe that compacted affect helps to create and maintain psychopathology. They go on to suggest that diagnosis, elaboration, and understanding of these compacted affect patterns by clients is beneficial and perhaps crucial to a client's behavior change process. They state, "The client has compressed his affect for good reason and one of those is that in its present form, the affect although anxiety provoking, is not as painful as it would be if it were expanded" (Kell & Mueller, 1966, p. 62). They concentrate on the compacted "theme" (the recurring tone, attitude, or view one has of himself that has come to symbolize the affect content) in their efforts to understand client behavior. In addition they believe exploration into the theme allows reliving and expansion of the initial compacted affect, resulting in a decompression of affect behavior. The importance of this exploration is clearly stated by Kell and Mueller:

> Unless the encysting threads of the compacted feelings are unwoven, thus facilitating the expansion of experiences, the counseling relationship will terminate with both client and counselor feeling dissatisfied as a result of having undergone a significant interpersonal failure. (Kell & Mueller, 1966, p. 62)

A view similar to Kell and Mueller's is expressed by Haggard and Isaacs (1966). After reviewing slow motion films taken during psychotherapy interviews, they conclude that clients seem to emit more micromomentary facial expressions when they are dealing with active conflict. They found that micromomentary expressions tend to be associated with denial statements and verbal blocking, and incongruent with concurrent verbal content and adjacent facial expressions. They also found that micromomentary expressions usually go unobserved when they occur and when film is played at normal speed. However, they find that these expressions can be observed when film is played at about one-sixth normal speed. Haggard and Isaacs believe that these compacted expressions may be a form of "temporal censorship" that acts as a safety valve to permit the very brief expression of unacceptable affects. They state:

> From this point of view the micromomentary facial expressions have a double benefit to the individual: he may indulge in some impulse expression with minimal risk of retaliation or rejection by the observer, and without arousing the anxiety that would ensue if he himself were aware of, or of having expressed the unacceptable impulse or affect. (Haggard & Isaacs, 1966, p. 165)

Haggard and Isaacs (1966) conclude that relatively little clinical or research attention has been given to micromomentary facial expressions. They speculate that the reason for the inattention may be due to a "perceptual defense" on the part of psychologists. They

ask: "Have we as adult observers learned not to see some aspects of what occurs before our eyes . . . [for] if one were to observe them they would activate impulses, conflicts, or anxieties which one had succeeded in forgetting" (pp. 164-165). A similar view is expressed by Loeb (1966). He believes that therapists cannot avoid the impact of compacted affects by ignoring them. He states: "The psychiatrist might behaviorally respond to the patient's compacted anger without the idea that the patient is angry ever coming into his consciousness" (p. 617). Loeb states that these rapid changes of affect are one means by which, as Freud stated, "the Unconscious of one human being can react upon that of another without passing through consciousness" (see Loeb, 1966, p. 614).

In summary, these clinicians have noted (a) that compacted facial affect may play a major role in the maintenance of psychopathology, (b) that psychotherapy clients may need to expand their compacted affects before other behavior changes can take place, and (c) that therapists may be unconsciously reacting to their clients' expressions of compacted affect and thus unknowingly impacting the therapeutic process (Kell & Mueller, 1966; Haggard & Isaacs, 1966; Loeb, 1966; Hinds, 1970).

Need

Although psychological clinicians have suggested that compacted affect serves a defensive function that

helps maintain maladaptive behavior, little research has been conducted to determine under what conditions and to what degree this affect transformation takes place. As previously mentioned, in their study of facial expression, Haggard and Isaacs (1966) found that rapid changes of expression occur when psychotherapy clients are in "active conflict." They recommend that persons in situations other than psychotherapy should be studied to determine the extent to which rapid changes of facial expression occur. To date no one has undertaken a study to analyze compacted facial affect in persons in other active conflict situations. The present study seeks to determine the extent to which compacted facial expressions occur in a nontherapy conflict situation.

Hinds (1976) and Inman (1976) have identified another need relevant to the study of compacted facial affect. They note a lack of instruments capable of measuring patterns of compacted expressions of affect. This is not a new problem. Investigators for over 100 years have had to contend with ways to measure rapid changes of facial expression. Darwin, in his book The Expression of the Emotions in Man and Animals (1872), states:

> The study of expression is difficult, owing to the movements being often extremely slight, and of a fleeting nature. A difference may be clearly perceived and yet it may be impossible, at least I have found it so, to state in what the difference consists. (p. 12)

Since Darwin's time, few studies have been conducted to determine the psychological meaningfulness of transient expressive behavior, and virtually no instruments have been developed to help in these efforts.

One measurement approach that shows promise is facial electromyography (EMG). Electromyograms have been found capable of providing subtle, quick, and continuous observations of facial activity. In his book, The Biology of Emotion, Jacobson (1967) makes a strong statement supporting the use of electromyographical recordings for the measurement of subtle affect. He writes:

> According to the ultrasensitive measurements during mental activities [including emotional ones] which have continued almost daily in my laboratory these past thirty-five years, a specific neuromuscular (EMG) pattern marks the character of each and every moment of their occurrence. . . . I here go further, suggesting that the nature of mental activities can be accounted for and depends upon specific recordable and repeatable neuromuscular patterns. (Jacobson, 1967, pp. 118-119)

Schwartz et al. (1973), in their studies of facial expression of affect, found that facial electromyography could accurately discriminate between depressed and nondepressed patients. In another study (Schwartz et al., 1974), they found discriminations could be made between happy, sad, and angry thoughts generated by subjects. They concluded that facial electromyography can provide a useful objective index of subtle emotional states. But, they note, their "preliminary but strong support" for the hypothesis that

electromyography can act as a qualitative and quantitative index of facial expression needs further study and clarification. Thus, electromyograms show promise in the study of subtle facial behavior. What is needed now, according to Hinds (1976), is the further development of procedures that may lead to a systematic research approach to the analysis of compacted facial affect.

Purpose

Compacted and sequenced facial affect has been noticed and often described but rarely studied in the last 100 years. Two important areas have been identified as needing further attention. They are the need to study the expression of compacted affects in persons other than psychotherapy clients and the need to develop instruments capable of accurately measuring compacted affect behavior.

The purpose of this study is to test for the occurrence of compacted facial affect after treatment with uncontrollable outcomes. The main thrust in designing the study was aimed at refining strategies, measures, and procedures in the study of compacted facial affect. In particular, these efforts were directed towards adapting the use of electromyograms to the study of transient facial expression. The main question this study will address is whether expressions of compacted affect are associated with maladaptive behavior patterns. Depression

has been identified as a major maladaptive behavior pattern maintained by compacted affect (Tomkins, 1962, 1963). However, this view is not universally held. Seligman (1975) has suggested depression is maintained by the reduced expression of all affect. These contrasting views will be briefly reviewed in the following section.

Depression, Compacted Affect, and Helplessness

Tomkins (1962) believes depression to be a sequencing of positive and negative affect, and that this type of sequencing creates and maintains this and other forms of psychopathology. He claims that depression is a continual sequencing of affect consisting of "an oscillation between increase and decrease of positive affect which alternately activates distress or anger and shame" (Tomkins, 1962, p. 290). In his view, depression can become chronic and, eventually, a stable character trait. This occurs when the oscillating sequences become compacted, unconscious, unassociated with the activating event, and used to defend against new experiences. (An extensive review of Tomkins' theory will be contained in Chapter II of this report.)

Another view of depression is set forth by Seligman (1975) as the learned helplessness theory of depression. He calls depression the common cold of

psychopathology: it is something that touches all of us, yet is the least understood and most inadequately investigated of all the psychopathologies. He believes that the cause of depression is the belief that action is futile. Seligman (1975) states, "The depressed patient believes or has learned that he cannot control those elements of his life that relieve suffering, bring gratification, or provide nuture--in short he believes he is helpless" (p. 93).

The primary characteristic of learned helplessness-depression is believed to be the generalization of a behavior pattern of responselessness that was previously associated with an uncontrollable situation to a current, controllable situation. Laboratory and clinical evidence finds the following traits associated with learned helplessness: the belief in an external locus of control, a lack of motivation to respond, and undermined ability to perceive success, and an initial period of heightened emotionality followed by responselessness (Hiroto, 1974; Seligman, 1975). In this view, "depression" (the human correlate of Seligman's 1975 animals' responses to conditions of learned helplessness) is equated with an initial increase in emotion, followed by a general lack of responding, or, an emotional deficit. In Seligman's (1975) words, it is "not doing anything at all."

> When a traumatic event occurs, it causes a heightened state of emotionality that can loosely be called fear. This state continues until one of two things happens: if the subject learns that he can control the trauma, fear is reduced and may disappear altogether; or if the subject learns he cannot control the trauma, fear will decrease and be replaced with depression. (Seligman, 1975, pp. 53-54)

Seligman's view of the etiology of depression is consistent with Tomkins' view up to the point where Seligman claims that "heightened emotionality" gives way to "not doing anything at all." Tomkins' theory would account for the reduction of overt affect activity during depression that Seligman describes by hypothesizing that the final stage of a transformation process compacts and combines facial affect to form an emotional "heiroglyphic." This "heiroglyphic" is generally unobservable to both respondent and observer and thus capable of being mistaken for "not doing anything at all."

The purpose of this study is to put to an experimental test these opposing views of emotional activity during depression. This test will be guided by the following hypotheses.

Hypotheses

Four hypotheses will be used to guide this exploration. The hypotheses reflect the three major characteristics of compacted affect. They are (a) that people shorten the duration of their affect and (b) repeat sequences of affect to (c) avoid the experiencing of new and painful, but potentially growth-producing, emotion.

The hypotheses are:

H_1:

Subjects treated with uncontrollable outcomes will exhibit significantly more changes of facial expression than will subjects treated with controllable outcomes.

H_2:

Subjects treated with uncontrollable outcomes will exhibit significantly more repeated changes of facial expression than will subjects treated with controllable outcomes.

H_3:

Subjects treated with uncontrollable outcomes will exhibit significantly fewer types of facial expression than will subjects treated with controllable outcomes.

H_4:

Subjects treated with uncontrollable outcomes will exhibit facial expressions of significantly shorter duration than will subjects treated with controllable outcomes.

Definition of Terms

In this study a few special terms are used. These terms and their definitions are:

Affect.--A complex concept with physiological, neuromuscular, and phenomenological aspects. Affect forms a subsystem of personality having motivational and homeostatic qualities which help give direction and

meaning to life. In this study, the terms "affect" and "emotion" will be considered synonomous.

Facial affect.--A major component of all affect experience. It includes innate and learned patterns of electrochemical, muscular, and felt facial activity.

Affect transformations.--Changes in the innate pattern of activation or expression of affect, usually achieved through learning.

Compacted affect.--Denotes a transformation consisting of at least two affects shortened in duration, combined one after another in a stereotyped sequence, and used repeatedly in response to an activating event.

Summary

The study was designed to explore the occurrence of compacted facial affect during learned helplessness conditions. Tomkins (1962) as well as Kell and Mueller (1966), Haggard and Isaacs (1966), and Hinds (1976) suggest that people use compacted sequences of affect to maintain stability when threatened with the experience of painful affect. To ward off the pain they call upon sequences of affect that, through repetition, have become so miniaturized and unconscious that they generally go undetected by both observer and exhibitor.

The important question this research study will address is whether the "emotional responselessness" (that

Seligman hypothesized accompanies learned helplessness) may consist of the repeated use of miniaturized sequences of affect that Tomkins believes helps to create and maintain depressive psychopathology.

Overview

Chapter II contains a review of related literature supporting the view that compacted affect plays a role in the maintenance of maladaptive behavior. Also to be found in Chapter II will be a review of the literature pertinent to the expression of emotion during learned helplessness. In Chapter III, the design, procedures, measures, and methods of analysis that are employed in the study are described. Chapter IV contains reports of the results of data analysis, and Chapter V will contain a discussion of the results and a summary.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The temporal dimension of emotional expression received theoretical attention during the nineteenth century. In the first section of this chapter, the works of Charles Darwin (1872), William James (1884, 1890), Sigmund Freud (1893, 1894, 1895a, 1895b, 1896a, 1896b, & 1899), and G. B. Duchenne (1876) will be reviewed. They provided the ground work for the current theoretical formulations reviewed in the following section. The final section of this chapter contains a review of learned helplessness theory and research linking learned helplessness to emotion and depression.

Theory

Compacted Affect Theory: An Historical Overview

The basis for recent facial affect theory was formed in the nineteenth century. Theorists such as Darwin (1872), Duchenne (1876), Bell (1806), Spencer (1855), Pediret (1867), and James (1890) gave attention to the fact as a source, expresser, and transformer of

affect. Darwin (1872) described affects ranging from joy to despair. He and his associates, through collective observation, catalogued 30 primarily facial descriptions of affect. Many of the observational methods Darwin developed for the study of emotion are still in use today. He believed that facial displays of affect had survival value in that they communicate the internal state of the organism to other members of the species. Also, he was one of the first to emphasize the importance of the temporal association of the emotions. He likened emotional expression to musical expression in that each individual emotion, like tones in a melody, is dependent upon the surrounding emotion for its expressive effect. But Darwin chose not to study the temporal dimension of emotion, noting that the task would be extremely difficult "owing to the movements being often extremely slight and of a fleeting nature" (Darwin, 1872, p. 12).

William James (1890) was another investigator who believed facial and other patterns of muscular movements played an important role in emotional experience. James paid particular attention to the subtle feelings of change which accompany emotion. James states,

> The changes are so indefinitely numerous and subtle that the entire organism may be called a sounding-board, which every change of consciousness, however slight, may make reverberate. The various permutations and combinations of which these organic activities are susceptible make it abstractly possible that no shade of emotion, however slight, should be without a bodily reverberation. . . .

> The next thing to be noticed is this, that every one of the bodily changes, whatsoever it be, is FELT, acutely or obscurely, the moment it occurs. (James, 1890, pp. 150-151)

While Darwin chose to study the character of the individual expressions of emotion, James believed that the study of transient patterns of expression is essential to understanding emotion. He criticized psychologists for not paying enough attention to the transient affective behaviors. James claimed the affect literature describing individual emotions (he termed them the "golden eggs" of emotion) generated by Darwin was "tedious," and "its pretenses to accuracy a sham," and he believed Darwinian methods of observation could not be used to study the more important transitive affect behaviors: the movement, order, succession, pacing, intensity, and duration of emotion. Another observation made by James, which is important to the study of compacted affect, is his notation that emotions were subject to "blunting." By blunting, he referred to the loss or reduction, achieved via learning, of physiological activity associated with emotion. He saw in blunting a means by which emotional expression could easily be reduced and transformed. Finally, James noted a close link between imagery and the muscular movements of expression. He believed that an image of the original "exciting fact" could cause an "actual revival" of the emotions associated with the imaged fact. James states,

"The cause is now only an idea, but this idea produces the same organic irradiations, or almost the same, which were produced by its original, so that the emotion is again a reality" (James, 1890, p. 474). He believed that an emotional temperament and lively imagination were the "necessary and sufficient conditions for an abundant emotional life." His descriptions of types of images (tactile, motile, visual, and auditory), and the effect of imagery upon affect experiences, gives a sense of the diversified imagery process that Tomkins (1962, 1963) and Jacobson (1967) describe as capable of transforming and organizing affects into stable behavior patterns.

Three years after the publication of James' The Principles of Psychology (1890), Freud published the first of his many articles on psychopathology (1893). In this work, and in a number of succeeding publications (on hysteria, 1896; the defence neuropsychosis, 1894, 1896; anxiety-neurosis, 1894, 1895; and obsessions and phobias, 1895), Freud presented his early view of the relationship of affect and affect transformation to psychopathology. Freud (1893), writing about hysteria, noted his and Breuer's original contention that recollection, in detail, of the original exciting trauma and its accompanying affect was essential to alleviating and eliminating hysterical symptomatology: "Recollection without affect is nearly always quite ineffective" (p. 28). Freud

believed that "hysterical patients suffer principally from reminiscences," and that these reminiscences were maintained by associated affects. He characterized normal and hysterical reminiscences in the following manner.

> After an accident, for example, the remembrance of the danger and the subsequent (weakened) reproduction of the terror is accompanied by the memory of the sequel, of the rescue and the consciousness of present security. The memory of an injury to the feelings is corrected by an objective evaluation of the facts, consideration of one's actual worth and the like, and thus the normal man succeeds by means of associations in dissipating the accompanying affect. . . . Our observations have shown that those memories which give rise to hysterical phenomena are retained with wonderful freshness and with full affective tone for a long period. (p. 31)

In "The Defence Neuro-psychosis" (1894), Freud extends his affect theory along new lines. First, he hypothesizes that in hysteria, persons learn to convert their painful affect-ideational excitations into some other bodily expression, and that when these same affect-ideational excitations are not "converted," there is a predisposition to other pathologies.

> If the capacity for conversion does not exist in a person predisposed to hysteria and yet the separation of its affect from an unbearable idea is nevertheless undertaken as a defence against the latter, then this affect must persist in the psychical sphere. Thus weakened, the idea remains present in consciousness, detached from all associations; but its affect, now freed from it, attaches itself to other ideas which are not in themselves unbearable, but which through this "false connection" grow to be obsessions. This is shortly the psychological theory of obsessions and phobias. (pp. 65-66)

Freud notes that the primary characteristic of obsessional affect is that it is "dislocated or

transposed." In "The Anxiety Neurosis" (1894), Freud extends further the concept of transposed affect to consider it a major mechanism in the maintenance of phobias. He states that the difference between phobias and obsessions is found in the fact that the transposed emotionality accompanying phobias is always morbid anxiety, while obsessions are maintained by persistent emotional states which can be made up of any of the innate emotions, such as fear, anger, and remorse. Another difference is that phobias do not rely upon a substitution or conversion of the affect-ideational excitation to create the pathology, but rely directly on an associational process that links the transposed anxiety to its original source. In a further important discussion of the role of transposed affect, which is of particular interest to the study of compacted affect, Freud (1896) maintains that pathological affect can be transformed from any one affect to any other discrete affect for the purpose of defensive relief. He gives the following example:

> The affect of reproach can with the aid of some psychical reinforcement transmute itself into any other unpleasant affect; when this has happened there is nothing to hinder the substituted affect any longer from becoming conscious. Thus self-reproach (for having performed a sexual deed in childhood) can easily transform itself into shame (lest another person should come to hear about it), into hypochondriacal anxiety (lest some bodily injury should result from the action which evoked the self-reproach), into dread of the community (fear of punishment by the world at large for the lapse),

> into religious anxiety, into delusions of reference (dread of betraying the deed), into dread of temptation (justified mistrust in the personal strength of moral resistance), and so on. (p. 165)

In The Interpretation of Dreams (1899), Freud explains the role of unconscious processes in the formation of transformed affect and resulting psychopathology. Once ideas and associated affects are transformed, via repression, and experienced only unconsciously, they can be further transformed by conflict generated in the unconscious. This occurs when the original pleasurable impulses that were thwarted, and which caused the now-avoided pain, seek new outlets.

The result can be a multi-level series of transformed ideas and associated affects. This complex system of associations, originally intended to avoid pain, can result in relatively stable pathological states.

> The theory of the psychoneuroses asserts as an indisputable fact that only sexual wishful impulses from infancy, which have undergone repression (i.e., a transformation of their affect) during the developmental period of childhood, are capable of being revived during later developmental periods . . . and are thus able to furnish the motive force for the formation of psychoneurotic symptoms of every kind. (Freud, 1899, p. 645)

Freud (1899) claimed that the role of transformed affect in psychoneuroses could best be understood by studying the technique of dream work. He claimed that in the dream work, the "quality" of the affect could not be changed, and that the transposed associational ideas (in latent form) were present together with the original

affect. The fact that affects could be repressed, transposed, and transformed, yet maintain their original "quality" in the dream work, was not a contradiction to Freud. It was just this seeming contradiction that made the interpretation of the pathological ideational material possible.

A brief summary of Freud's theory of affect transformation follows. First, a painful impulse is subject to control by efforts to terminate its expression. The associated ideas and the affect itself are then stored in memory where the ideational material can readily be worked upon by any defense mechanism. Then, once the idea has been repressed or otherwise defended against, the affect itself is subject to substitution or reduction of quantity by the expression of other affects. These "transformations of affect" are the second step in a continuing and complex process aimed at the successful control of the original painful impulse and its associated affect. The transformed associated affects are therapeutically important because they must be reunited with the dissociated memories, and clinically they are important because, as Freud states, when working with the psychoneuroses, "the affects are the constituent which is least influenced and which alone can give us a pointer as to how we should fill in the missing thoughts."

Thus Freud, in his early theoretical works, laid down a framework for understanding psychopathology, based

upon a foundation of transposed and transformed painful affects. Freud expanded on these ideas throughout the rest of his life, and the psychoanalytic movement in general has been the most prominent theoretical source of ideas about the role of affect in psychopathology.

From the analytic point of view the avoidance of painful affect has come to be known as the primary motivator for the psychological defense mechanisms employed by those suffering from all forms of psychopathology. Fenichel (1945) writes, "Thus, in the last analysis any defense is a defense against affects. 'I do not want to feel any painful sensation' is the first and final motive of defense" (p. 161).

It is surprising that the psychoanalytic movement, which has based much of its theory of psychopathology on affect defenses, and the resulting transformation of affect, and which has been a major source of ongoing speculative theory about affect behavior, has given little attention to the particulars of affect expression. An important nineteenth century contribution to understanding the particulars of facial affect expression came from G. B. Duchenne. Duchenne (1862, 1876) took meticulous care in describing the effect of over 100 pairs of facial muscles on facial affect expression. Duchenne suggested that most pairs of facial muscles were expressers of discrete affects. His precise use of electrical

stimulation and photographs to produce and record affect expression remains one of the most comprehensive efforts to catalogue discrete affect expression. Duchenne was a French neurologist who said his work was generated by one ambition: "To demonstrate as never before a living anatomy in man." His major tool in this endeavor was the stimulation of facial nerves with electrical current and the recording of the resulting muscle and expressive activity.

Duchenne's studies are important to the study of compacted facial affect in three respects: (a) his method of study--electrical stimulation and photographic recording of muscle activity--pioneered the use of electrophysiological recording techniques; (b) he charted the nerve and muscle structure of the face for later researchers; and (c) his work demonstrated the subtle and important effect of individual muscle action upon facial expression.

Duchenne believed the expressions of the face are produced by contractions of four classes of muscles: completely expressive, incompletely expressive, complementary expressive, and inexpressive muscles. By completely expressive, he meant those muscles which have the exclusive role of representing completely a specific expression by their isolated action. The other three categories are made up of muscles that act either in succession or in combination to form a complete expression.

Duchenne refers to the expressions produced by these four categories of muscles as "primary" expressions. He states:

> The essential expressions of the face (produced either by the partial contractions of the completely expressive, or by the combination of the incompletely expressive muscles with the complementary expressive muscles) are primary, because in association they can produce a harmonious ensemble and create other expressions, the significance of which is more extended and which are complex expressions. (Duchenne, 1862, p. 584)

What Duchenne meant by a complex expression--a singular expression created by two or more muscles capable of individual expressiveness acting in association--no longer is the common meaning of the term. Complex expression has come to mean the facial activity consisting of two or more expressions expressed simultaneously on the face (Ekman & Friesen, 1967, 1969; Ekman, Friesen, & Ellsworth, 1972; Nunnenmaa, 1958; Plutchik, 1962; Tomkins & McCarter, 1964). This "given instant" interpretation of complex expression has become so prevalent that most studies of transient facial behavior are efforts to determine the variety of discrete affects expressed over time, rather than the nature of the rapid sequencing of expressions of discrete affects (Izard, 1971; Schwartz, 1973, 1974). Thus, researchers have tended to neglect one of Duchenne's main assertions: that emotional expression is primarily a process of associated singular expressions.

In summary, Darwin, James, and Freud believed that changes in innate affect expression played a role in the maintenance of painful psychological states. In addition, Darwin, James, Duchenne, Spencer, Bell, and Pediret speculated that the expressions of the face had a direct relationship with affect and offered a theoretical framework from which to explore the hypothesized relationship. While these nineteenth century works offered a rich field for further investigation into transient affect expression, changes in the way investigators conceptualized human behavior drew attention away from the face and emotion. The discrediting of the then-popular "science" of facial physiognomy and the advent of "behaviorism" were two of many developments that led to the diminution of research in facial affect between the late 1800s and early 1950s.

One result of this change is that research psychologists, for most of this century, have discounted the affects, seeing them only as internal, subjective, and unmeasurable phenomena. Izard (1971) attributes this lack of scientific attention to three things: (a) the tendency of behavioral scientists to view emotion as a global, unitary concept which makes operational definition so difficult as to preclude it as a researchable problem, (b) the dominance of logical positivism and s-r drive reduction principles in psychological theory, and

(c) the lack of an adequate theory dealing with separate and distinct affects that can be studied by repeatable and specific operations.

But perhaps the major problem has been that when scientists have chosen to study facial affect, they have concentrated their attention on verifying the existence of categories or dimensions of facial expression. The problematic history of this Darwinian type "golden egg" approach has had a depressive effect on affect research. Initially, such research concentrated on labeling categories of naturally occurring or posed expressions. Later other approaches included the study of the expressive value of different portions of the face; how to determine deceptive from natural categories of expression; the phylogenetic and ontogenetic development of categories of facial expression; the best means of recording facial expression; how to train judges to accurately differentiate expressions; poser and/or judger variables that effect ratings; the differentiation of learned and innate expressions; and cross-cultural studies to determine the universality of different expressions. The resulting collection of inconclusive and oftentimes contradictory data, based on widely divergent methodologies, left reviewers of the research wondering why so much attention had been given to an area of study that had consistently proven unrewarding.

Duffy (1941) in his review of the research suggested that because of the problem in measuring emotion, the concept should be abandoned altogether and other concepts developed where the meanings would not be so idiosyncratic, and research would prove more feasible. Facial studies conducted between 1900 and 1950 were reviewed by Bruner and Tagiuri (1954), and they concluded that there are no invariable facial patterns of emotional expression. Brown and Farber (1951) note that all previous efforts to classify discrete emotions based upon facial expression had ended in failure. And Klopfer (1975), in assessing the research conducted in the area of facial affect expression in the last 100 years, believes we are still largely where Darwin (1872) left us in his study of affect expression. Klopfer states, "In sum, even the post Darwinian studies show little improvement in conception or design from their predecessors, nor have they advanced us significantly from the time of Darwin" (p. 406).

A number of recent developments have caused a change in that trend. Theoretical and empirical support for transient facial affect and the role played by affect transformations in human behavior have provided a broader base for investigative efforts into the behavioral expressive realm of the affects (Tomkins, 1962, 1963; Izard, 1971, 1972, 1975; Ekman, 1972; Ekman & Friesen, 1975, 1976; Ekman, Friesen, & Ellsworth, 1972; Gellhorn, 1964; Jacobson, 1967; Schwartz, 1973, 1974; Plutchik, 1962).

Recently, Sylvan Tomkins (1962, 1963), in his two-volume work Affect Imagery and Consciousness, has used and refined the theories of nineteenth century investigators to form a comprehensive theory of affect behavior. Like Darwin, he lists and describes a number of primary and secondary affects and goes on to assert that these affects are innate and that the face is the primary site of their expression. He also posits, as did Duchenne, that the face, with its extensive network of nerve and muscle tissue, is a source as well as an expresser of affect. Tomkins, like Freud and James, believes that affect dynamics and affect transformations have a modifying affect on human behavior. His view that awareness and control of the face is important when trying to change problematic behavior is of clinical and theoretical importance (Kell & Mueller, 1966; Haggard & Isaacs, 1966; Jacobson, 1967; Izard, 1971). Tomkins' work details the effect of the transformations that he terms "miniaturized" and "combined" affect. In this area, his theory forms the theoretical basis for this study. His work will be reviewed in depth in the following section.

Compacted Affect: Current Theory

This study of compacted facial affect rests primarily on Tomkins' (1962, 1963) theory of affect behaviors. In particular, it is based upon his statements about miniaturization of affect, central control of imaged affect,

consciousness of transformed affect, and the results of these transformation processes.

Two significant aspects of Tomkins' theory are (a) that he considers the affect system to be a major motivating system and (b) that he defines affect behavior as primarily facial behavior. He lists eight primary affects that can be differentiated facially and that are universal across cultures. They are: joy, interest, surprise, fear, anger, shame, contempt, and distress.

Tomkins believes that there is a wide variety of innate activators of these affects but that the commonalities of the activators can be summarized with a few simple principles.

He believes affects can be activated by stimulation (density of neural firing) that is on the increase, on the decrease or that maintains a steady level. These innate activators of affect respond to and amplify the pattern of stimulation created by the person-environment interaction and thus provide motivation for further action. Figure 2.1 graphically represents the relationship of density of neural firing over time to affect activation.

The innate system of activation and expression of affect can be changed dramatically by a number of learned transformation that can permanently alter the ongoing experiencing of affect. Tomkins gives extended

treatment to numerous transformations which can affect the compacting process. The effects of miniaturization, imagery, and consciousness will be reviewed.

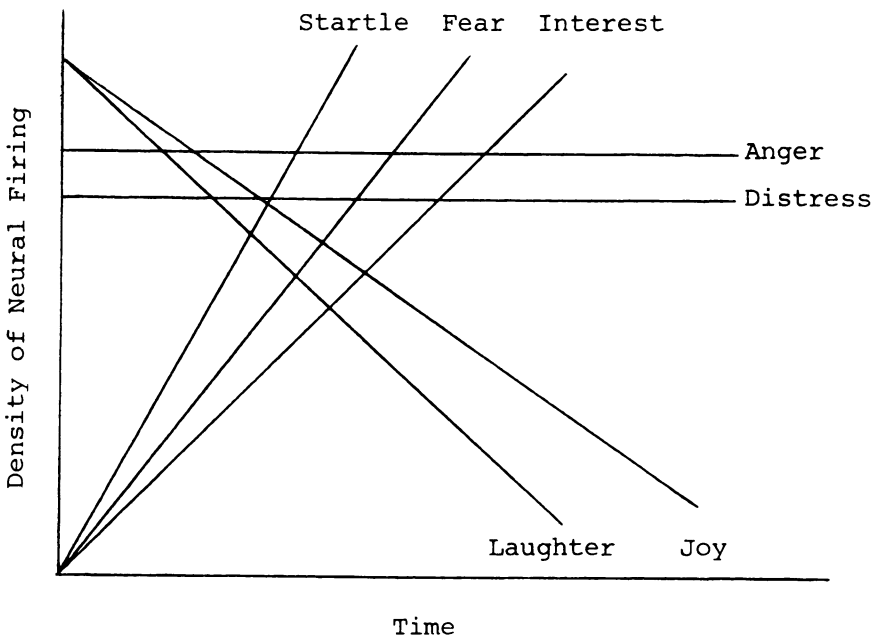


Figure 2.1. Graphical representation of a theory of innate activators of affect (Tomkins, 1962, p. 251).

Miniaturization. Miniaturization is the characteristic and repetitive shortening of duration and expression of an affect. Tomkins (1962) describes it in the following way:

> A transformation similar to habituation, yet distinct, is what we have called miniaturization, in which the innate complex organization is further and further compressed almost to the point of invisibility to both the respondent and the observer. Thus the smile may be emitted for a half second rather than a few seconds. At the same time, the mouth does not open and the broadening characteristic of the smile may be reduced to a slight widening--no more than a quick tug on

> the lips. Similarly the affect of shame may be miniaturized into a very slight lowering of the eyes, or even a partial lowering of the lids or a slight relaxation of the neck muscles which support the head in an upright position. . . . There are innumerable other ways in which all, or crucial parts, of innately patterned affective responses are compressed. (pp. 307-308)

Imaged affect. Innate affect can be transformed and stored centrally as an image which is subject to recall. Tomkins believes that these remembered experiences provide another means for reducing and compacting affect. Centrally stored imaged affect can be experienced upon retrieval with much greater speed than can normal affect. Furthermore, internal control of such retrieval allows tremendous freedom to compose combinations of affect.

> Such conscious control over affect imagery also makes possible another kind of modification of the innate affects--that of combinations of affects. Although each affect is innately patterned, one may learn to emit two affects to the same stimulus or to emit two affects simultaneously as continuing moods somewhat independent of the environment. The combinations of affects leave each expression intact, side by side, but they may also produce resultants which correspond to no simple affect. It is in just such combinations that the common language is most likely to be deficient. To the extent to which affective phenomena of this kind escape language they will also remain opaque. Indeed much of the incommunicability of experience, mystical and prosaic, is a consequence of somewhat idiosyncratic combinations of affect which the individual finds as difficult to analyze for himself as to communicate verbally to another. (Tomkins, 1962, pp. 317-318)

Single affects, once miniaturized, can be stored, selectively combined with others, and then stored as a combined set. The set itself is then subject to miniaturization, storage, and recall. The interplay of miniaturization and imagery allows for a continual transformation of innate patterns of affect expression, particularly in regard to temporality and potency of expression.

Conscious control. The process of compacting affect can be complicated by loss of control over compacted affect experience. The loss of consciousness is achieved by the habitual use of the compacting process, which, like any skill that is well practiced and committed to memory, can lead to partial surrender of voluntary control. One result of this loss of consciousness is that learned sequences of miniaturized affect can become stable character traits that are relatively invulnerable to behavior change strategies. Tomkins believes that such transformations, which are the consequence of a defensive strategy to control affect, "may become so skilled a strategy that the individual becomes unconscious of what was once a voluntary act and ultimately unable to decontrol his habitual posture of defense" (Tomkins, 1962, pp. 320-321).

Tomkins summarizes by pointing out that these transformations are inter-affect dynamics and that efforts to change and reverse their courses need to start with an

understanding of the sequencing, rather than of external, seemingly related events. He states:

> It should be noted in all of these types of learning that these are inter-affect dynamics unrelated to other aspects of experience. It is of course possible to learn that whenever one feels distress another individual will do something to comfort one and thus reduce the feeling of distress. We are calling attention to a type of learning somewhat different from this, in which the activated affect becomes the stimulus for its own intensification and gradual reduction, or for its own sudden reduction through becoming the stimulus for the activation of a particular competing affect. Whenever such learning becomes stabilized, the individual's account of the rise and fall of his own feelings either mistakenly relies on plausible events going on at the time or seems to him frankly beyond explanation. Thus if distress is learned to activate more distress, the individual may believe that the problems which initiated his distress are more serious and more insoluble than he at first realized. When one examines such phenomena closely, one will find that an individual whose affects have been so transformed by learning always encounters problems which appear to become more difficult as he struggles with them and that this is an artifact of the learned sequence in which mild distress activates more intense and more enduring distress. In order to diagnose this type of learning, one must establish invariance of the affective sequences which are independent of the course of external events. (Tomkins, 1962, pp. 325-326) (Emphasis added.)

Carroll Izard (1971) takes Tomkins' views further and speculates about the impact on behavior of imaged and micromomentary affect.

Izard suggests that micromomentary imaged expressions of affect may be maladaptive because of their lack of precision, specificity, and complexity, and, depending upon the completeness of the affect experience they

afford, may be a crucial variable in human creativity and talent. He states,

> I doubt that the mediating memory image could ever be as precise, specific, and complex as the neuromuscular activity of the face and the face-to-brain feedback. Consequently, the subjective experience would be less precise and less complete. The degree of precision and completeness which would accrue from the addition of the diminished or micromomentary facial activity to the memory image may make the difference between the person who can experience and respond to the subtleties and nuances of emotion and the one who cannot. (Izard, 1971, p. 193)

Edmond Jacobson (1967) offers a different approach to the study of compacted affect. Jacobson does not hypothesize a transformation process that shortens emotion. He suggests instead that all emotion is in part miniscule neuromuscular contraction patterns. He believes these contraction patterns are goal-oriented responses that are central to man's being. He believes that the emotion process is often triggered by imagery. Jacobson suggests that imagery may be the key to understanding micromomentary affect expression. He believes that maladaptive emotion is based in part on imagery below threshold that escapes autosensory observation. Jacobson claims that "States of anxiety and depression are triggered by pertinent visual imagery which may be persistent or intermittent, clear or vague, steady or fleeting, observable or unobservable" (Jacobson, 1967, p. 143). To remedy such maladaptive imagery based emotion, Jacobson believes people must be taught first to discriminate imagery which

pertains to maladjustments. If such discriminations can be made, then one can learn to selectively relax imagery pertaining to maladjustment.

The problem entailed in this behavior change process is that the more "vague," "intermittent," "fleeting," and "unobservable" the images are the more likely they are to be "subvisualized" (below the lower limits of visualization) and thus the less they are subject to conscious autosensory discrimination and ultimately to any behavior change strategy (i.e., relaxation).

Paul Ekman (1971) presents a social-cultural explanation for the occurrence of micromomentary affect. Ekman suggests affect may be controlled and transformed by a learned system of "display rules." He believes display rules govern facial behavior on a habitual basis. Display rules transform affect by intensifying, deintensifying, neutralizing, or masking one affect by the expression of another. Ekman and Friesen (1969) and Wilson (1976) suggest that these transformation processes may result in "micro-displays" of affect. They believe micro-displays are defensive attempts to govern one's affect via deception. Wilson suggests that if self-deception is the aim of micro-displays of affect, repression is the psychodynamic process at work. (Freud believed affects themselves could not be repressed but that repression of ideas associated with instincts or affects could <u>suppress</u>

the development of affect and transform affect expression; thus suppression and control of unwanted affect is the prime aim of repression (Freud, 1915). Thus, micro-displays would seem to be an indication that either affect suppression or affect control has taken place. In this sense the concept of micro-displays would seem similar to Tomkins and Izard's concept of miniaturized affect.

In summary, regardless of the concept employed (miniaturized, miniscule, micromomentary, or micro-display) or the purpose hypothesized (motivation, evaluation, communication, or deception) the impact of patterns of compacted affect on person-environment interactions is believed to be maladaptive.

These theoretical formulations have explanatory power for the process of learned helplessness. For if vague and fleeting emotion-evaluation processes triggered by imagery are transferred from one uncontrollable situation, the ability to adjust to the new situation will be limited by one's ability to control the vague and fleeting image-induced emotion; emotion that is generally conceded to be outside of conscious control efforts.

Research adding support to the above theoretical formulations will be reviewed in the following section.

Compacted Affect: Research Support

Landis and Hunt (1939) in their studies of the startle response offer insight into the expression of miniaturized and combined affect. Using high-speed film (up to 3,000 frames per second) they studied over 100 subjects' body and facial reactions in response to a revolver shot. They found the following behaviors associated with the startle response: mean reaction time of eye blink from beginning to full closure was 15 thousandths of a second, the mouth was widened for 67 thousandths of a second, and it took 83 thousandths of a second to initiate head movements. The average time for the total response to take place and for facial features to return to pre-startle conditions was 1/4 of a second. Of greater interest to this study is their finding that following the startle response comes a number of secondary responses. These responses are fleeting and oftentimes stylized versions of emotions. Within this secondary period affects such as surprise, fear, disgust, annoyance, and interest can be perceived in fleeting patterns of expression. These secondary behaviors were observed to change with age. Children having clearer and fewer responses, basically consisting of fear, but with advancing age they observed increasing use of stylized and variable emotional responses.

They conclude their observations about secondary expressions by stating,

> Thus there are facial expressions of amusement, surprise, disgust, and others which, while they are not as immediate and uncontaminated by learning as is the startle pattern, come as quick, involuntary responses to the stimulation and may be regarded as more primary and primitive than the voluntary and communicative usage of facial expressions mentioned above. The study of the minor changes in expression, from an involuntary, though learned, expression of surprise up to the voluntary use of the expression as a means of deliberate social communication, will help to bridge the gap between the innate and the acquired, between the primitive individual response and the social stereotype. It is in this gap that our secondary behaviors lie. (Landis & Hunt, 1939, p. 136)

Landis and Hunt also set out to analyze the question of the mixing or blending of discrete secondary expressions. Taking the then popular concept of "interwoven" secondary reactions (blended or mixed expression consisting of one expression appearing before another abates), they set out to analyze using high-speed film the occurrence of interwoven expressions. Landis and Hunt conclude:

> With the "interwoven" sort of reaction there is some confusion between the two behaviors if the photography is done at normal camera speeds, but ultra-rapid motion pictures separate the consecutive behaviors much more clearly and dispel the confusion that bothered Straus. For this reason we see little value in keeping the temporal categories of "interwoven" and "postponed" secondary behavior. (Landis & Hunt, 1939, p. 144)

Schwartz, Fair, Greenberg, Forna, Klerman (1974a), in a series of studies using electromyograms (EMG) to examine facial activity in response to self-generated

affect states, conclude: EMG provided a sensitive indicator of self-generated mood states and discriminated between subjects' happy, sad, and angry imagery.

In one study, using a within subject design, 13 subjects were asked to generate happy and sad imagery and feelings while facial electromyograms were taken from sites above the right corrugator, depressor, zygomatic, and mentalis muscles. Results indicated that happy and sad imagery resulted in significantly different patterns and that these imaged patterns were miniatures of the overt facial expressions of these emotions.

In a variation of the previous study (1974), Schwartz et al. added the affect of anger and included the measurement of the temporalis and orbicularis muscles. This study supported the original findings. That is, imaged-induced covert facial expression of the affects of anger, sadness, and happiness can be discriminated between, using electromyography.

In another study, Schwartz, Fair, Greenberg, Mandel, and Klerman (1974) compared the facial expressions displayed by symptomatically depressed, clinically depressed, and nondepressed subjects.

Twelve female volunteer subjects with Zung Self Rating Depression Scale (Zung, 1965) scores below 50, comprised the normal group. A group of six females with scores above 50 comprised the "symptomatic depressed"

group, and 12 clinically depressed subjects (with scores above 56) comprised the third group.

EMG's were taken from sites above the corrugator, frontalis, depressor, and masseter facial muscles. All subjects were asked to image sad, angry, happy, and "typical day" feelings.

The results indicate that normal subjects' happy, sad, and angry imagery can be differentiated electromyographically, even when no overt expressions can be perceived. They state: "unbeknowns't to either the casual observer or the subjects themselves, they are actually generating small but distinct patterns of facial muscle activity that can be recorded and quantified by facial EMG."

When normals are compared to clinically and symptomatically depressed subjects, the depressed subjects show similar sad and angry EMG patterns but dissimilar happy and "typical" facial patterns. Depressed subjects' typical patterns resembled sadness while normals resembled happiness.

The authors conclude that EMG can provide a sensitive and objective measure of subtle facial adjustments. Additionally they conclude that it is possible to discriminate between normal and depressed subjects in a manner that confirms clinical diagnosis.

Haggard and Isaacs (1966) used slow motion film to study micromomentary facial expressions (MME's) of psychotherapy clients. MME's are facial expressions that are so short lived that they seem to be "quicker-than-the-eye." The authors had initially noticed that in analyzing films of psychotherapy hours, clients would occasionally change their facial expression from a smile to a grimace and back to a smile in less than 1/5 of a second. They then set out to analyze this phenomenon more systematically.

Rather than speeding up the photography (as Landis and Hunt did), the authors chose to analyze slow motion film. They adopted the following "objective" scoring system: (a) judges were told to assume a state of passive alertness; (b) film was divided into scoring units with 120 judgments required for each 20-second unit; and (c) each expression change should involve movement from one identifiable affect to another. They then compared scores obtained at slow speed to changes identified at normal speed and found that judges observed 2½ times as many changes when the film was run at slow speed. They also found that many of the observed changes frequently occurred in "bursts," compounding the difficulty for those judgments made at normal speed. Of interest to this study is their observation that one depressed client showed great variability from session to session. During

one hour the patient emitted 98 MME's but during another hour, "characterized by a stubborn depressive mood," only emitted three MME's. Thus suggesting depression is characterized by reduced expression of micromomentary affect.

They offer a number of suggestions for future exploration. They question: (a) whether MME's may interfere with other behaviors, such as speech or cognition; (b) whether situational factors affect the expression of MME's; (c) whether MME's may be efforts to express unacceptable affects; or (d) whether MME's may be transference, counter-transference, phenomena that signal therapeutic progress or impasse.

They conclude by asking, might micromomentary expressions indicate the existence of an ego mechanism which we may call temporal censorship.

> Thus, in addition to the ego controls which regulate or even inhibit the expression of particular impulses or affects or the awareness of particular fantasies or memories we assume that these controls also have a temporal dimension. (Haggard & Isaacs, 1966, p. 165)

Inman (1976) using a similar format asked trained judges to identify on the faces of taped subjects, the number and type of changes in affect expression displayed (in slow motion and normal speed tape playback). He found that judges observed a significantly greater number of changes at slow speed than at normal speed but that their accuracy of identification of affect

scores were no greater at slow speed. These findings tend to support Haggard and Isaacs' contention that there may be a separate temporal dimension to the ego control of affect expression.

The research exploring the expression of compacted affect is limited and inconclusive. All that can be said at this time is that the findings tend to support the contention that the display of compacted affect coincides with psychological stress and maladaptive behavior.

Learned Helplessness--Depression and Emotion

Seligman (1973, 1975) presents a theory of depression that suggests that depression results from learning that response and outcome are independent. Thus, the individual believes events are uncontrollable and he feels helpless. The features that Seligman believes are common to both learned helplessness and depression are summarized in Figure 2.2.

Seligman and associates have conducted a number of studies designed to test the learned helplessness-depression assumptions. Miller (1974; Miller & Seligman, 1975) treated depressed and nondepressed subjects with either escapable noise, inescapable noise, or no noise. During subsequent anagrams testing the depressed no noise subjects and the nondepressed inescapable subjects performed similarly on the anagrams test. Both groups'

	Learned Helplessness	Depression
SYMPTOMS	Passivity	Passivity
	Difficulty learning that responses produce relief	Negative cognitive set
	Dissipates in time	Time course
	Lack of aggression	Introjected hostility
	Weight loss, appetite loss, social and sexual deficits	Weight loss, appetite loss, social and sexual deficits
	Norepinephrine depletion and cholinergic activity	Norepinephrine depletion and cholinergic activity
	Ulcers and stress	Ulcers (?) and stress
		Feelings of helplessness
CAUSE	Learning that responding and reinforcement are independent	Belief that responding is useless
CURE	Directive therapy: forced exposure to responses that produce reinforcement	Recovery of belief that responding produces reinforcement
	Electroconvulsive shock	Electroconvulsive shock
	Time	Time
	Anticholinergics; norepinerphrine stimulants (?)	Anticholinergics (?); norepinephrine stimulants

Figure 2.2. Summary of features common to learned helplessness and depression (adapted from Seligman, 1975, p. 106).

performances were significantly different from the other groups studied, thus indicating that depressed and inescapable conditions may result in similar symptomatic behavior, at least in regard to subsequent task performances.

In another learned helplessness study comparing subjects pretreated with escapable or inescapable noises, Gatchel, Paulus, and Maples (1975) found that subjects treated with an escapable noise and who demonstrated behavioral deficiencies on an anagrams task initially showed significantly heightened depression anxiety and hostility scores as measured by the Multiple Affect Adjestive Check List but that these differences dissipated after completion of the anagrams task. They concluded that the results support Seligman's (1975) contention that learned helplessness is associated with a heightened state of emotionality. They also noted that the heightened scores dissipated after successful solving of anagrams and that this suggests that regaining control over outcomes may be critical in efforts to successfully treat affect disorders induced through uncontrollability.

Klein, Fencil-Morse, and Seligman (1975) treated depressed and nondepressed subjects with an unsolvable, solvable, or no-problem task. They found that the depressed no-problem subjects performed similarly to nondepressed unsolvable subjects on a subsequent anagrams

task. They concluded that learned helplessness and depression cause similar behavioral deficits.

Gatchel, McKinney, and Koebernick (1977) treated depressed and nondepressed subjects (as measured by the Beck Depression Inventory) with escapable, unescapable, and passively listened to aversive tones. Then all groups were asked to solve a series of anagrams. This study supports the findings of Miller and Seligman (1975), Gatchel, Paulus, and Maples (1975), and Hiroto and Seligman (1975). They found that depressed subjects and nondepressed inescapable subjects demonstrated parallel deficits on the anagram tasks, thus in their words "demonstrating a similarity of impairment in naturally occurring depression and laboratory induced learned helplessness" (Gatchel, McKinney, & Koebernick, 1975, p. 25).

The authors administered the Multiple Affect Adjective Check List before and after the experimental treatments. They found similar elevated scores for inescapable subjects after treatment and depressed subjects prior to treatment. They concluded that these results also indicate a similarity between learned helplessness and naturally occurring depression.

Skin resistance was continuously monitored throughout the experiment and revealed that learned helplessness was associated with less phasic skin

conductance responding, while depression was associated with greater responding to uncontrollable adversive tones. The authors conclude that the data indicate that there is not a direct parallel between learned helplessness and naturally occurring depression with respect to electrodermal responding.

Miller, Seligman, and Kurlander (1975) tested a depressed anxious, a nondepressed anxious, and a nondepressed nonanxious group of subjects with a set of discrimination problems. They found that depressed subjects evidenced a lack of expected control during the discrimination task as well as performance deficits on discrimination problems, as compared to nondepressed anxious and nondepressed nonanxious subjects. On another measure, time taken to shut off an alarm, the groups did not differ. The authors hypothesized, based on the learned helplessness model of depression, that depressed subjects would show behavioral and expectancy deficits of a greater magnitude than nondepressed subjects. They concluded that the results tended to support the learned helplessness model of depression.

In an effort to determine if helplessness (like depression) generalizes across tasks and motivational systems, Hiroto and Seligman (1975) conducted a series of experiments where they pre-treated subjects with (a) escapable, inescapable, or no tone, followed by

anagram testing; (b) solvable, unsolvable, or no problem, followed by anagrams testing; (c) escapable, unescapable, or no tone, followed by shuttle box tone avoidance testing; and (d) solvable, unsolvable, or no discrimination problems, followed by shuttle box tone testing. The results of the experiments indicate that there was significant interference on all the test tasks (both anagrams and tone) for those pre-treated with unescapable tone when compared to those pre-treated with escapable or no tone. They performed more poorly on all the anagram and tone solving measures: trials needed to find anagram (or shuttle box) pattern, number of failures to escape, and mean response latency.

They also found significant differences between those pre-treated with unsolvable problems when compared to those treated with solvable and no problems for both anagrams and shuttle box testing. Thus, the four experiments resulted in test task interference on all the measures. The authors conclude,

> . . . since it is general across motivations and tasks we suggest the process induced by uncontrollability may be the rudiment of a [depression like] "trait" . . . this speculation entails the consequence that our procedure for producing debilitation should also produce those symptoms associated with mild depression. (Hiroto & Seligman, 1975, p. 327)

The results of the helplessness studies, while not always conclusive, taken together, tend to offer strong support for the learned helplessness model of

depression. In addition, when the Multiple Affect Adjective Check List was given (Seligman, 1975; Miller & Seligman, 1975; Gatchel, Paulus, & Maples, 1975; Gatchel, McKinney, & Koebernick, 1977) both depressed and learned helplessness subjects (depressed subjects before treatment and inescapable subjects after treatment) tended to evidence higher depression, anxiety, and hostility scores than control subjects. The heightened anxiety and hostility scores support Seligman's contention that learned helplessness results in an initial state of heightened emotionality but tend to contradict his belief that depression is a state in which affectivity is characterized by responselessness.

In summary, compacted facial affect has received theoretical attention for over 100 years, but the difficulty scientists have had in quantifying the temporal dimension of affect expression has hindered scientific research attempts to study the compacting process.

Recent theories of psychopathology and psychotherapy have brought back to attention the need to study compacted facial affect. Recent theorists suggest that compacted affect plays a major role in the creation and maintenance of maladaptive behavior and hypothesize that those suffering from such maladaptive behavior need first to de-compress their affect before other behavior changes can take place.

Tomkins (1963) hypothesizes that depression is a maladaptive behavior pattern that is maintained by heightened levels of compacted facial affect, while Seligman (1975) suggests that depression is a state typified by reduced levels of affect expression. To date, no studies have focused directly upon the question of whether depression consists of increased or decreased levels of transient facial affect.

CHAPTER III

DESIGN OF THE STUDY

Overview

The purpose of this study is to test for the occurrence of transient changes of facial expression during learned helplessness conditions. To test for the effects of learned helplessness on facial expression, two groups of subjects were treated with a series of uncontrollable or controllable stimuli. One group of subjects could not escape a repeated presentation of a loud tone (no-escape/learned helpless group); the other (escape group) could. After treatment with the tone, both groups were given the task of trying to solve 20 single-solution anagrams. During the anagram-solving task, subjects were monitored for facial behavior. Data derived from facial electromyograms taken from sites above the frontalis, masseter, depressor, and mentalis facial muscles were used to test for the effects of treatment on transient changes of facial expression. Data collected were analyzed using analysis of variance procedures. The remainder of this chapter describes the design of the study.

Sample

Thirty-four students volunteered to participate in the study. But, due to a noisy electrical ground which caused the computer to fail erratically, data on 16 subjects (the lost data subjects and their yoked counterparts) were lost.

The following description of the sample relates to the remaining 18 subjects.

Eighteen volunteer subjects, who were students attending classes at Michigan State University or Lansing Community College during the summer of 1977, signed up to participate in the study (see Appendix A). The subjects were told that the experimenter was interested in studying physiological and psychological responses to problem-solving tasks; that the study consisted of an auditory and a cognitive task; that the auditory task included listening to a loud tone that was mildly unpleasant; that they would be given a sample of the tone prior to beginning their participation in the study; and that they could discontinue participating at any time during the course of the experiment. In addition, subjects were told that since the experiment involved listening to and responding to a tone, students with hearing impairments or disabilities could not be included as subjects in the study. Finally, the subjects were also informed that physiological recordings would be

taken during the tasks and that after completion of the experiment the experimenter would go over their recordings with them.

Apparatus

The "helplessness" factor was manipulated by the presentation of a series of 20 trials with an escapable or inescapable 3000 Hertz 95 decibel tone (±.5 db). The tone was produced by an audio generator and was delivered to subjects through earphones. On each trial, the tone could be terminated by subjects in the escapable group by pressing two buttons on a button box (see Appendix B) in a predetermined "correct" order (see Appendix C). The inescapable group subjects were given the tone independent of button-pressing.

Twenty single-solution five-letter anagrams (Appendix D) were used to test for the effects of the experimental treatment on subsequent task-solving ability. The anagrams were presented on a closed-circuit television monitor, with the numbers one through five printed below the letters. For example, the word "apron" was presented as the anagram: $\begin{matrix} R\ O\ P\ N\ A \\ 1\ 2\ 3\ 4\ 5 \end{matrix}$. The anagram could be solved by pressing the five numbered buttons on the response panel in the correct sequence to spell the word "apron." Thus, the correct pressing sequence of "apron" is 5(A)-3(P)-1(R)-2(O)-4(N). The number sequence 5-3-1-2-4 solved all 20 anagrams.

Electromyograms (EMG) were taken from the skin surface above the frontalis, mentalis, depressor, and masseter facial muscles (see Figure 3.1). The EMG readings were used to identify facial activity. Four pairs of miniature Beckman Ag/AgCl surface electrodes were used to record the EMGs for six consecutive seconds at the beginning of each anagram trial. EMG activity was channelled through a Grass polygraph and into a computer (PDP 11/40 DECLAB System) for storage. The EMG recording was sampled at 250 samples per second (Hz) by the computer. The EMG voltage was integrated over each 200 msec of each six-second sample, which yielded 30 integrated EMG scores. The data gathered from the four facial sites were used to test for the expressive effects of the experimental treatment. EMG recordings from the four facial sites included surface activity in the general area above the designated muscle; however, for reasons of convenience, activity will be reported as muscle-specific activity.

The laboratory where the experiment took place consisted of two rooms: the Subject Room and the Recording Room. The Subject Room contained a chair, a closed-circuit television (CCTV) monitor, earphones, a subject response panel, and behavior-monitoring devices for recording facial activity, heart rate, respiration, and digital blood volume activity. The latter three recording

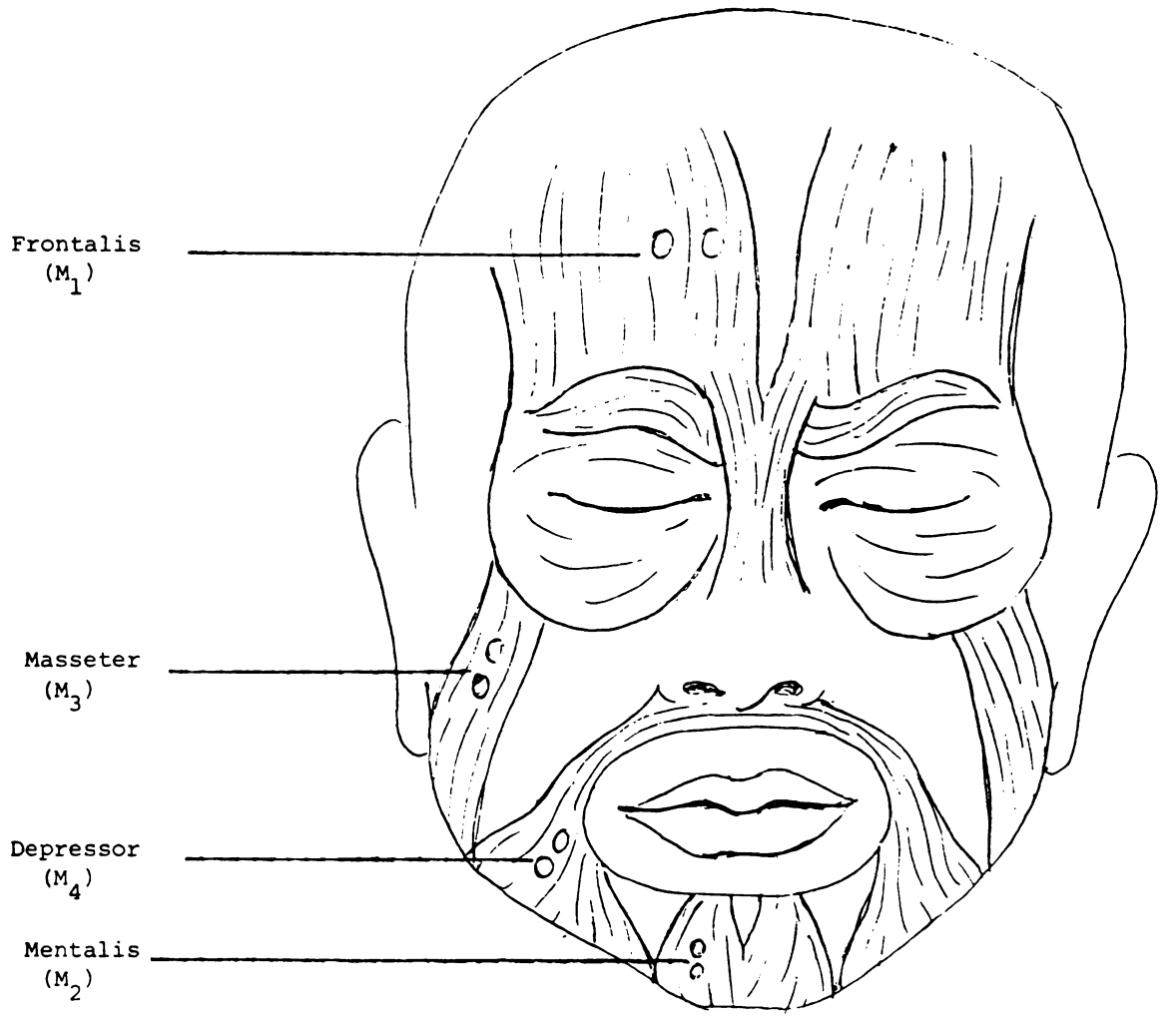


Figure 3.1. Placement of surface electrodes. Schematic drawing of the face showing the locations of the frontalis, mentalis, masseter, and depressor muscles, and the locations of the surface recording electrodes.

devices were used to help mask the facial focus of the study. The Recording Room contained the Grass polygraph and the Digital Equipment Corporation PDP 11/40 Computer System. The computer was connected to the equipment in the Subject Room. Thus, once the subject was "wired" to the monitoring devices and received initial instructions for each task, all following instructions, feedback, and recording of physiological and task-solving behaviors proceeded automatically. The subject was visually monitored through a glass partition between the Subject and Recording Rooms.

Procedure

The 18* subjects were randomly assigned to the two treatment groups. Subjects were run individually, and "paired," such that the duration of tone received by a subject in the inescapable group was identical to the duration of tone received by the preceding subject in the escapable group.

Orientation

When the subject arrived for participation in the study, he was led into the Subject Room. There he was asked to read the following "orientation" sheet outlining the study:

---

*Additional subjects were run, but due to a noisy electrical ground which caused the computer to fail, data on these subjects (and their yoked counterparts) were lost.

We are interested in psychological and physiological processes involved in thinking and problem-solving. The present experiment consists of three tasks: an auditory task (listening and responding to tones), a cognitive task (rearranging mixed letters, called anagrams, to spell out a word), and an imagery task** (imagining some scenes). The instrumental and cognitive tasks will last about 20 minutes each, the imagery task about 10 minutes. You will be given detailed instructions for the tasks later. The entire experiment will last 90-120 minutes.

Some physiological responses will be recorded during the experiment. We use standard recording methods and the recordings will not be painful or harmful. It is important, however, that you remain still during the experiment, and avoid abrupt changes in breathing (holding your breath, sighing, or taking deep breaths), so that we can record your physiological activity accurately.

Why are we doing this experiment? We are interested in understanding psychological and physiological changes which may accompany thinking and problem-solving. When the experiment is over we will show you your physiological recording and discuss it with you, if you are interested. If you call the lab at the end of the experiment (end of August) after we complete analysis of the data, we will be glad to tell you what we learned in this experiment and explain more details of the research.

We ask that you do not share information about the experiment with other participants in your class until after they have participated.

The Tone Task

Once the subject had read the orientation sheet, he was asked to listen to a sample of the tone that was used in the experiment. If he desired to continue participation, he was asked to sign a consent form (Appendix E) and was then fitted with the physiological monitoring devices by a lab assistant. Subjects were seated in

---

**The imagery task was a separate experiment and will be reported elsewhere.

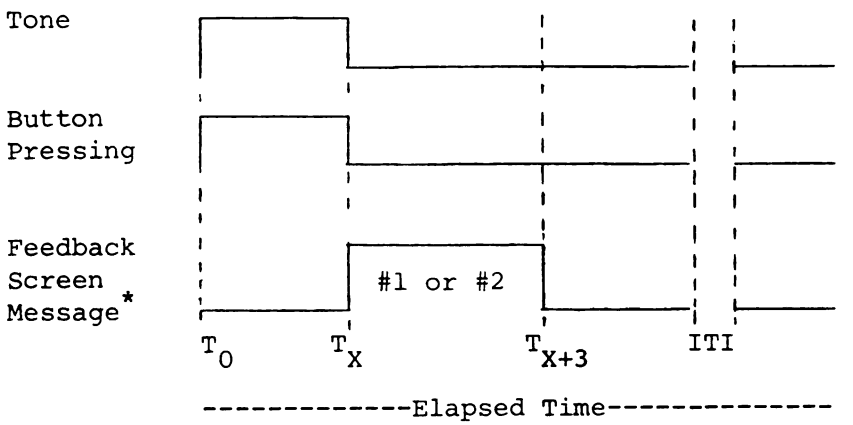
the chair with the CCTV situated in front of them. The subject's response panel was attached to the right arm of the chair. Subjects in both groups were given the following printed instructions for the auditory task:

> From time to time you will hear a loud tone. When the tone comes on there is something you can do to stop it. If you press the red and green buttons in front of you in the correct sequence and the tone stops, the words YOU STOPPED TONE will be shown on the T.V. screen in front of you. If you do not press the correct sequence, after a period of time, which will vary from trial to trial, the tone will stop automatically and the words TONE STOPPED AUTOMATICALLY will be shown on the T.V. screen.
>
> From time to time you will be given a new problem (new sequence of button presses) to solve. The number of button presses in the new sequence will be presented on the T.V. screen before each new problem begins, e.g., the message "4 BUTTON PRESSES" will indicate that the correct sequence on the following trials requires a total of four presses of the green and red buttons.
>
> Your job is to discover the sequence of button presses that will terminate the tone. During the course of the experiment, please move as little as possible since movement may interfere with our physiological recording. TRY TO AVOID UNNECESSARY MOVEMENTS.

After the subject had read the instructions, he was informed that the experiment would start in about five minutes and that if he needed to communicate with the experimenter, talking out loud would be heard in the next room (via intercom) and the experimenter would respond. During this five-minute period, four six-second pretreatment baseline electromyogram recordings were taken. These were manually Schmitt-triggered and edited for interfering movements (artifacts) such as yawns,

eyeblinks, and swallows. Once the baseline measures were taken, the treatment task began. The treatment was computer-programmed to proceed automatically with presentation of tone, monitoring of button-pressing, tone termination, and presentation of feedback.

Each subject was instructed that the tone could be terminated if he pressed the correct button sequence (see Appendix C). However, only the subjects in the escapable group could actually terminate the tone by pressing the correct button sequence; subjects in the inescapable group could not. The time of tone duration of subjects in the escapable group was computer-recorded, stored, and presented to the immediately following inescapable group subjects. Subjects in the escapable group who pressed the correct sequence of buttons terminated the tone and received the message YOU STOPPED TONE on the CCTV monitor. Otherwise, they received five to seven seconds of tone and the message TONE STOPPED AUTOMATICALLY on the CCTV screen. The paired subjects in the inescapable treatment group always received the same duration of tone on each trial as the preceding escapable subject received on that trial, but they were always given the message TONE STOPPED AUTOMATICALLY on the CCTV screen. The process is illustrated in Figure 3.2.



T_0 = tone begins

T_X = five to seven seconds, or completion of correct sequence of presses

ITI = Intertrial Interval = 20 to 30 seconds

*Screen Messages:

#1: YOU STOPPED TONE

#2: TONE STOPPED AUTOMATICALLY

Figure 3.2. Time chart for one trial of the auditory task.

The Anagrams Task

After each subject completed the auditory task, the lab assistant returned to the room and handed the following written instructions for the anagrams task to the subject:

> Your task is to figure out a series of anagrams. An anagram is a word which is presented with its letters in a scrambled order. Your job is to figure out the word and then spell it out correctly using the keyboard in front of you.
>
> Notice that the buttons on your keyboard are labelled with numbers. The anagrams will appear on the TV screen before you and beneath each letter there will be a number. Once you have figured out the word you will have to determine the proper sequence of numbers to correctly spell the word on your keyboard. The idea is best illustrated by an esample.
>
> A typical anagram as it appears on the T.V. screen will look like this:
>
> U G A R S
> 1 2 3 4 5
>
> First, you should ignore the numbers and try to figure out the word. In this case, the word is "sugar." Once you know the word, look at the numbers to determine the proper sequence of numbers to correctly spell the word. In this case, the first letter is "s" so the first number is 5. The second letter is "u" so the second number is 1. The third letter is "g" so the third number is 2. The fourth letter is "a" so the fourth number is 3. The fifth letter is "r" so the fifth number is 4. The sequence of numbers to spell "sugar," then, is 5, 1, 2, 3, 4 and you must press the buttons on your keyboard in this order--first button 5 (for "s"), then button 1 (for "u"), then button 2 (for "g"), then button 3 (for "a"), and then button 4 (for "r").
>
> When an anagram first appears on the screen you will see the word THINK printed below it. A few seconds later the word THINK will be replaced by RESPOND. DO NOT begin to press buttons until the word RESPOND appears, even if you figure out the word immediately. We are interested in how quickly you can solve each anagram, so press your buttons as soon as you know the word and the message RESPOND comes on.

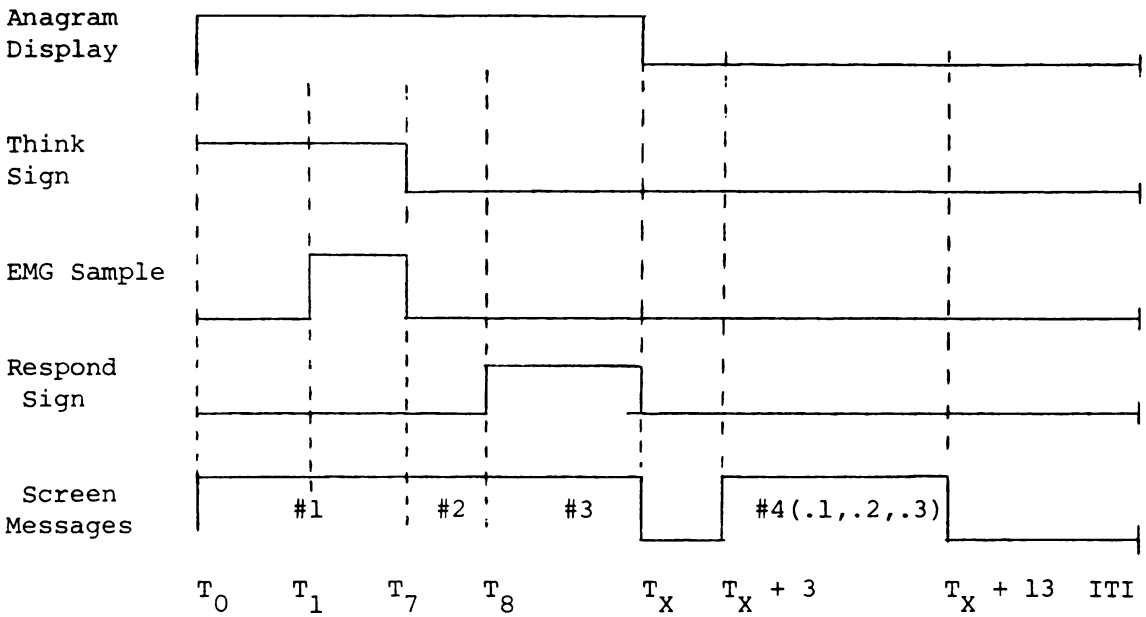
> If you hit a wrong button while spelling a word you can press button number 8 to erase what you have pressed so far. Then you can start spelling that word over from the beginning. However, once you have pressed the fifth and last button for a word the erase button will no longer work, so you must catch your mistakes before you finish spelling the word.
>
> There may be a pattern or principle by which to solve the anagrams, but that is up to you to figure out. After you have pressed the buttons, the word you typed in will be shown on the T.V. screen. There is a time limit of 45 seconds for solving each anagram. If you fail to figure out a word in 45 seconds, the words TIME UP will appear on the screen. There will be a brief wait between anagrams. TRY TO AVOID UNNECESSARY MOVEMENTS.

After the subject read the instructions, the anagrams task began. Again, as in the tone task, the anagrams task was computer-controlled to present the anagrams on the video screen, present feedback, and store problem-solving and physiological behavior.

Figure 3.3 is a time chart illustrating the sequencing of the anagrams task.

Debriefing

After the subject completed the experiment, the experimenter entered the room, removed the monitoring devices, and answered any initial questions. Then, the general purpose of and rationale for the procedures were explained. Special attention was paid to explaining and answering questions about the treatments. This included exploring any reactions the subjects may have



T_0 = Program Display Begins

T_X = 45 seconds if subject has not pushed five buttons.
= less than 45 seconds if subject has completed five button presses.

ITI = 22 to 37 seconds.

Screen Messages:

#1: I U P M O
1 2 3 4 5

THINK

#2: I U P M O
1 2 3 4 5

#3: I U P M O
RESPOND

#4.1: O P I U M
CORRECT

OR #4.2 P O I U M
INCORRECT

OR #4.3 TIME UP

Figure 3.3. Anagrams task time chart (one trial)

had to the procedures. The debriefing concluded with reviewing the polygraph printout of the subject's physiological behavior.

Stages of Electromyogram Data Gathering

Electromyograms (EMG) were continuously recorded at each of the four muscle sites during the six seconds (T_1 to T_7) of each of the 20 anagram test trials.

The first stage was the conversion of continuous EMG voltage to EMG scores (numerical representations of integrated EMG voltages). The computer sampled the continuous EMG voltage entering the computer 250 times per second and converted each voltage sample to a number. The yield from each six-second EMG sample was 1500 (250 per second X 6 seconds) numerical representations of raw data. The computer then applied an integration formula to each set of 50 numbers for each 200-msec time period of each six-second sample. This yielded 30 integrated EMG scores (5 per second X 6 seconds) (Figure 3.4A).

The next stage was the transformation of integrated EMG scores into Z-scores. Each EMG data point was compared to the mean at-rest baseline EMG for each site to determine a change score (C/EMG) (Figure 3.4B). A distribution was formed for each muscle site, using all of the C/EMG scores from that site. Z-scores (based on C/EMG scores) were then determined for each C/EMG data point (Figure 3.4C).

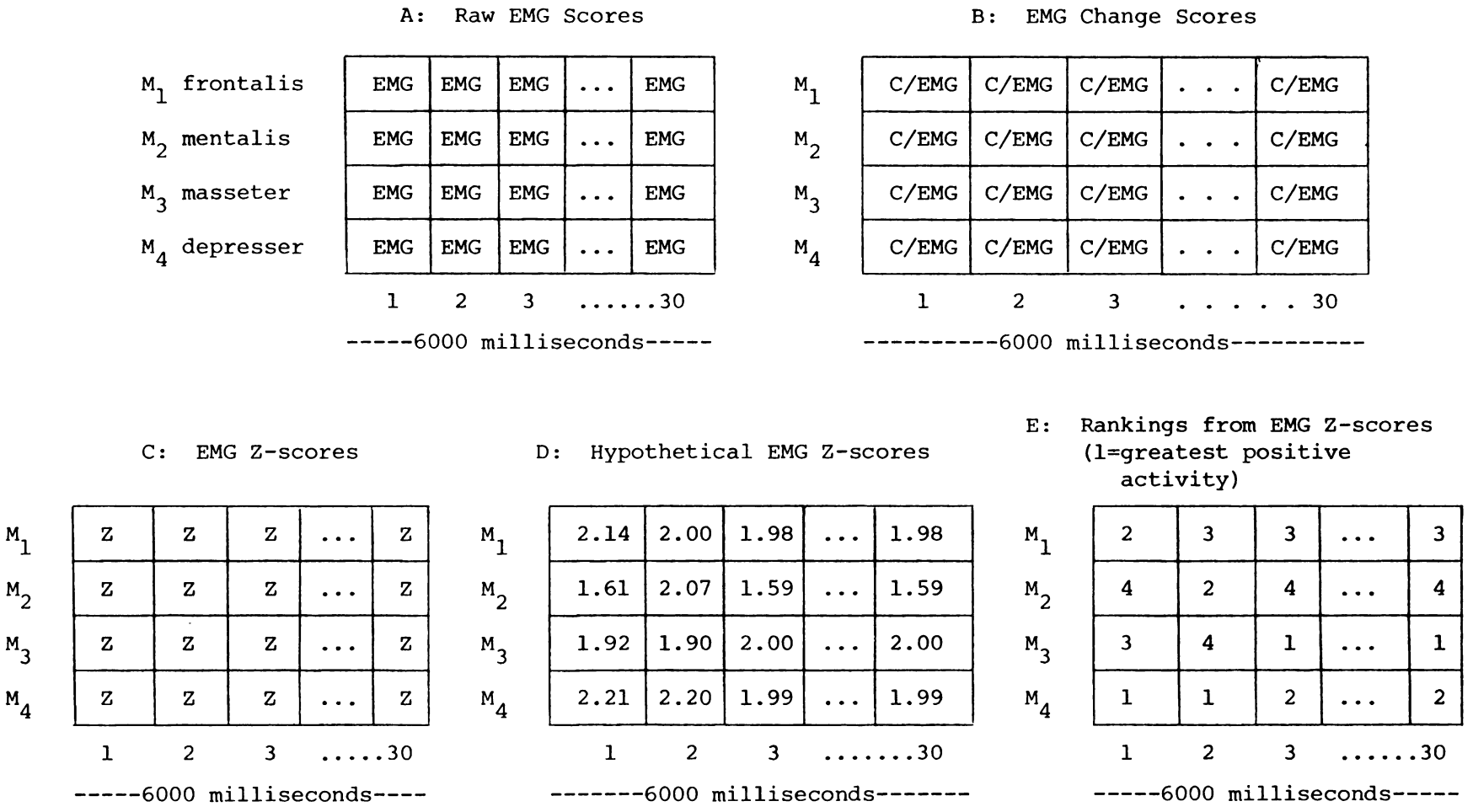


Figure 3.4. Stages of electromyogram data gathering. (Flow chart depicts stages of data gathering for one anagram task trial.)

EMG Z-scores were used to rank each of the muscle sites, ranging from greatest change activity to least change activity for each 200-msec time period. Using hypothetical numbers, Figure 3.4D and E illustrates this process for three time periods. This was carried out for all 600 time periods (30 time periods per trial X 20 trials).

The rank orders were used to determine muscle order and muscle perseveration (runs) for EMG Z-score activity. Muscle pattern was determined by ranking (from 1 to 4) the facial recording sites for each period in descending order of EMG Z-score activity. Each possible order (pattern of muscle activity) was assigned a number (Figure 3.5). Muscle pattern numbers were assigned to all 600 time periods for each subject. Using the rank orders from Figure 3.4E, the first three muscle patterns would be 20, 21, 17.

Muscle pattern perseveration was determined by the number of time periods that a muscle pattern was maintained once it was expressed.

The dependent measures were derived from EMG Z-score muscle pattern and muscle pattern perseveration data.

Design

The design tested for the effects of the helplessness induction procedure on changes of facial expression.

Pattern Number		Possible EMG Z Muscle Orders 1 2 3 4 = Rank Order
(1)	=	M_1 M_2 M_3 M_4
(2)	=	M_2 M_2 M_4 M_3
(3)	=	M_1 M_4 M_2 M_3
(4)	=	M_1 M_4 M_3 M_2
(5)	=	M_1 M_3 M_2 M_4
(6)	=	M_1 M_3 M_4 M_2
(7)	=	M_2 M_1 M_3 M_4
(8)	=	M_2 M_1 M_4 M_3
(9)	=	M_2 M_3 M_1 M_4
(10)	=	M_2 M_3 M_4 M_1
(11)	=	M_2 M_4 M_1 M_3
(12)	=	M_2 M_4 M_3 M_1
(13)	=	M_3 M_1 M_2 M_4
(14)	=	M_3 M_1 M_4 M_2
(15)	=	M_3 M_2 M_1 M_4
(16)	=	M_3 M_2 M_4 M_1
(17)	=	M_3 M_4 M_1 M_2
(18)	=	M_3 M_4 M_2 M_1
(19)	=	M_4 M_1 M_2 M_3
(20)	=	M_4 M_1 M_3 M_2
(21)	=	M_4 M_2 M_1 M_3
(22)	=	M_4 M_2 M_3 M_1
(23)	=	M_4 M_3 M_1 M_2
(24)	=	M_4 M_3 M_2 M_1

Dominant Site ----Order--

M_1 = Frontalis
M_2 = Mentalis
M_3 = Masseter
M_4 = Depressor

Figure 3.5. Muscle pattern numbers. (Muscle sites ranked in order of decreasing activity.)

That is, it tested whether treatment with escapable vs. inescapable stimulus (the tone) affected facial expression during later task-solving activities. The data were analyzed in two trial blocks of 10 anagrams trials each. The decision to analyze the EMG data in two sets of 10 trials each was based on Seligman's (1975) observation that there are two stages of affective reaction to learned helplessness induction. The first stage is a state of heightened emotionality, followed by a state of reduced emotionality. Even though Seligman (1975) believes that the stages of affectivity following uncontrollable events are solely an induction phenomenon, it was decided that trial block analysis could give additional information about the affectivity, and the possibility of affect stages, accompanying the process of helplessness generalization. This 2 X 2 design is illustrated graphically in Figure 3.6.

To test for the effects upon the facial changes of expression, the following dependent variable measures were used: (a) facial lability (FL), defined as the number of times each facial muscle pattern changed from one 200-msec time period to the next, divided by the total number of possible changes; (b) repeated facial pattern changes (RFC), defined as the number of times that a facial muscle pattern change was the repeat of a previous change, divided by the total number of possible pattern changes;

		Trials 1 - 10				Trials 11 - 20			
TREATMENT	Ss	FL	RFC	Patterns	Duration	FL	RFC	Patterns	Duration
Escape	1 9								
No-escape	10 18								

FL = Facial Lability

RFC = Repeated Facial Changes

Patterns = Number of Facial EMG Patterns

Duration = Time of Average Pattern Run

Figure 3.6. Design: Effects of treatment on facial behavior

(c) the mean number of patterns expressed per trial; and

(d) the average duration of pattern "runs" in milliseconds.

The following example illustrates the process for facial lability and repeated facial pattern changes for five 200-msec time periods. If the facial patterns expressed were numbers 4 4 17 17 6 in time periods (200-msec intervals) one through five, respectively, then there would have occurred two facial changes. They were the change from pattern four to 17 and 17 to six during time periods two to three and four to five, respectively. Thus, two changes would be divided by four (the total number of possible changes), for a FL score of .50. There are no repeated facial pattern changes: the two pattern changes that occurred, four to 17 and 17 to six, occurred only once each. A repeated change would have occurred if one of these changes had occurred again.

Hypotheses

Eight research hypotheses guided this study. They concerned the effects of treatment on subsequent facial expression of affect.

The hypotheses are:

H_{1a}:

The facial lability (FL) scores for trial block number one will be significantly larger for the inescapable group than for the escapable group.

H_{1b}:

The facial lability (FL) scores for trial block number two will be significantly larger for the inescapable group than for the escapable group.

H_{2a}:

The repeated facial change scores (RFC) of the inescapable group will be significantly larger than the RFC of the escapable group in trial block number one.

H_{2b}:

The repeated facial change scores (RFC) of the inescapable group will be significantly larger than the RFC of the escapable group in trial block number two.

H_{3a}:

The inescapable group will display significantly fewer facial patterns than the escapable group in trial block number one.

H_{3b}:

The inescapable group will display significantly fewer facial patterns than the escapable group in trial block number two.

H_{4a}:

The facial patterns displayed by the inescapable group will be of significantly shorter duration than those displayed by the escapable group in trial block number one.

H_{4b}:

The facial patterns displayed by the inescapable group will be of significantly shorter duration than those displayed by the escapable group in trial block number two.

Analysis of variance (ANOVA) procedures were used to test for the effects of treatment on facial expressive behavior. An alpha level of .05 was selected for all univariate tests.

Test of Learned Helplessness: Treatment Effects

The effects of the helplessness induction procedure on problem-solving behavior were tested. This involved a test of the escape vs. no-escape experimental treatments on subsequent anagram-solving ability. Four anagram task-solving behaviors were recorded and comprised the dependent variables. They were: (a) response time for correct solutions; (b) number of trials with correct solutions; (c) number of trials with incorrect solutions; and (d) number of trials with elapsed time of 45 seconds without the fifth button being pressed to complete the button-pressing sequence (number of trials terminated with the presentation of the message TIME UP on the CCTV screen). The hypotheses tested were:

H_5:

The inescapable group will have significantly longer mean response time for correct solutions than will the escapable group.

H_6:

The inescapable group will have significantly fewer trials resulting in correct solutions than will the escapable group.

H_7:

The inescapable group will have significantly more trials resulting in incorrect anagrams solutions than will the escape group.

H_8:

The inescapable group will have significantly more trials terminated with the TIME UP message presented on the video screen than will the escape group (response time = 45 seconds without first button being pressed).

This design is graphically illustrated in Figure 3.7.

TREATMENT	Ss	Response Latency	Correct Trials	Incorrect Trials	Time-up Trials
Escape	1 9				
No-escape	10 18				

Figure 3.7. Learned helplessness test.

Summary

The purpose of this study was to test for the effects of treatment with a helplessness-inducing procedure on expression of facial affect. Eighteen subjects participated in the study. All subjects were volunteers and were students enrolled in courses at Michigan State University or Lansing (Michigan) Community College. Subjects were placed into two treatment groups. One group could not escape the repeated presentation of a loud tone (no-escape group), the other group (escape group) could. After treatment with the tone, both groups were given the task of trying to solve 20 single-solution anagrams. During the anagram-solving period, subjects were monitored for electromyographically measured facial behavior and anagram-solving behavior. The facial and anagram-solving data collected were analyzed using analysis of variance.

CHAPTER IV

ANALYSIS OF THE DATA

The study was designed to assess the effects of inescapable and escapable tone on transient changes of facial expression during a subsequent anagrams task.

Hypothesis Testing: Effects of Treatment on Facial Expression

Analysis of variance was calculated on four measures of facial expression: Facial Lability (FL), Repeated Facial Changes (RFC), Mean Number of Facial Patterns Displayed (Patterns), and Mean Duration of Pattern (Duration). Analyses of variance were calculated independently for each measure on each of two anagram trial blocks: Trial block number one contained the first 10 anagram trials and trial block number two contained the second 10 trials. A 5% rejection region was selected for all univariate tests.

Table 4.1 gives the group means for the four facial measures for each of the trial blocks.

Table 4.1

Experimental Group Means of the Four Facial Measures During Both Anagram Trial Blocks

	Block #1				Block #2			
	FL*	RFC**	Pat-terns	Duration/ msecs	FL*	RFC**	Pat-terns	Duration/ msecs
Escape	.415	.236	4.5	962	.469	.259	5.2	669
No-Escape	.575	.331	5.6	397	.528	.273	5.9	635

*FL = Facial Lability

**RFC = Repeated Facial Changes

Hypotheses

The first two hypotheses were concerned with comparing the changes in facial expression (FL) exhibited by each group during the first 10 and second 10 anagram trials. The null hypotheses are:

Ho_{1a}:

There will be no significant difference in facial lability (FL) scores between the escapable and inescapable groups for trial block number one.

Ho_{1b}:

There will be no significant difference in facial lability (FL) scores between the escapable and inescapable groups for trial block number two.

The alternative hypotheses are:

Ha_{1a}:

The facial lability (FL) scores for trial block number one will be significantly larger for the inescapable group than for the escapable group.

Ha_{1b}:

The facial lability (FL) scores for trial block number two will be significantly larger for the inescapable group than for the escapable group.

A statistically significant difference was obtained between treatment groups for facial lability scores for trial block number one ($F = 4.57$, df 1/16, $p = .023$), but not for trial block number two ($F = .66$, df 1/16, $p = .28$). Therefore, the null hypothesis for trial block number one (Ho_{1a}) was rejected in favor of the alternative, while the null hypothesis for trial block number two (Ho_{1b}) was not rejected at the $p < .05$ level of significance.

Further analysis of facial lability scores reveals no main effect for trial block ($F = .013$, df 1/16, $p = .45$), nor an interaction effect ($F = 2.25$, df 1/16, $p = .075$). Figure 4.1 depicts graphically the relationship between facial lability scores of treatment groups and trial blocks. Table 4.2 summarizes the facial lability univariate analyses. These comparisons indicate that inescapable subjects changed their pattern of facial expression more often than escapable group subjects

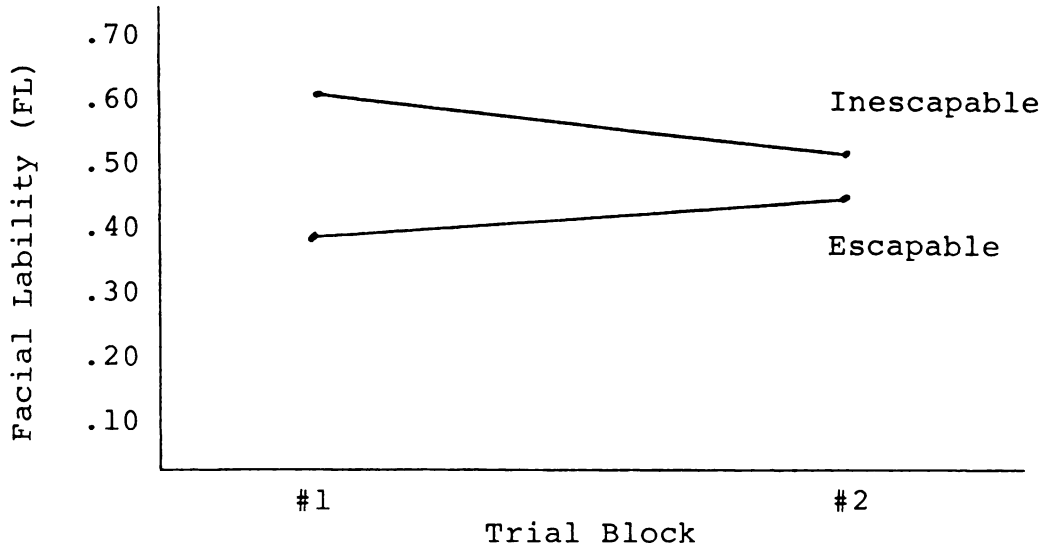


Figure 4.1. Facial lability group means.

Table 4.2

Summary of Facial Lability Analysis of Variance

Factor	F =	P =
Block #1 TR1 X TR2	4.57	.023*
Block #2 TR1 X TR2	.66	.28
Block #1 vs Block #2	.013	.45
Interaction	2.25	.075

*Significant at alpha $p < .05$. (One-tailed tests)

TR1 = Escapable Treatment Group

TR2 = Inescapable Treatment Group

during the first 10 anagram trials and during the second 10 trials but that their scores converged during the second trial block.

The second set of hypotheses was concerned with comparing the repeated facial change (RFC) scores obtained by the treatment groups during the first and second trial blocks. The null hypotheses were:

Ho_{2a}:

There will be no significant difference in repeated facial change scores (RFC) of the escapable and inescapable groups for trial block number one.

Ho_{2b}:

There will be no significant difference in repeated facial change scores (RFC) of the escapable and inescapable groups for trial block number two.

The alternative hypotheses are:

Ha_{2a}:

The repeated facial change scores (RFC) of the inescapable group will be significantly larger than the RFC of the escapable group in trial block number one.

Ha_{2b}:

The repeated facial change scores (RFC) of the inescapable group will be significantly larger than the RFC of the escapable group in trial block number two.

A significant difference was found between the treatment groups for repeated facial change scores in

trial block number one ($F = 7.11$, df 1/16, $p = .008$), but not for trial block number two ($F = .270$, df 1/16, $p = .31$). Thus, the null hypothesis for trial block number one (Ho_{2a}) was rejected in favor of the alternative, while the null hypothesis for trial block number two (Ho_{2b}) was not rejected at the $p < .05$ alpha level.

Additional analyses indicate there was no main effect for trial blocks ($F = .77$, df 1/16, $p = .30$), but there was a significant interaction effect ($F = 4.11$, df 1/16, $p = .029$).

Figure 4.2 depicts the relationship of repeated facial change scores of treatment groups and trial blocks. Table 4.3 summarizes the repeated facial change univariate analyses.

Figure 4.2 also illustrates that the repeated facial change scores of the inescapable group were higher during both trial blocks but that the scores of the treatment groups converged during the second trial block.

The third set of hypotheses is concerned with comparing the effects of treatment upon the mean number of facial patterns displayed by each group during the first and second anagram trial blocks. The null hypotheses are:

$\underline{Ho_{3a}}$:

There will be no significant difference in the number of facial patterns displayed by the escapable and inescapable groups in trial block number one.

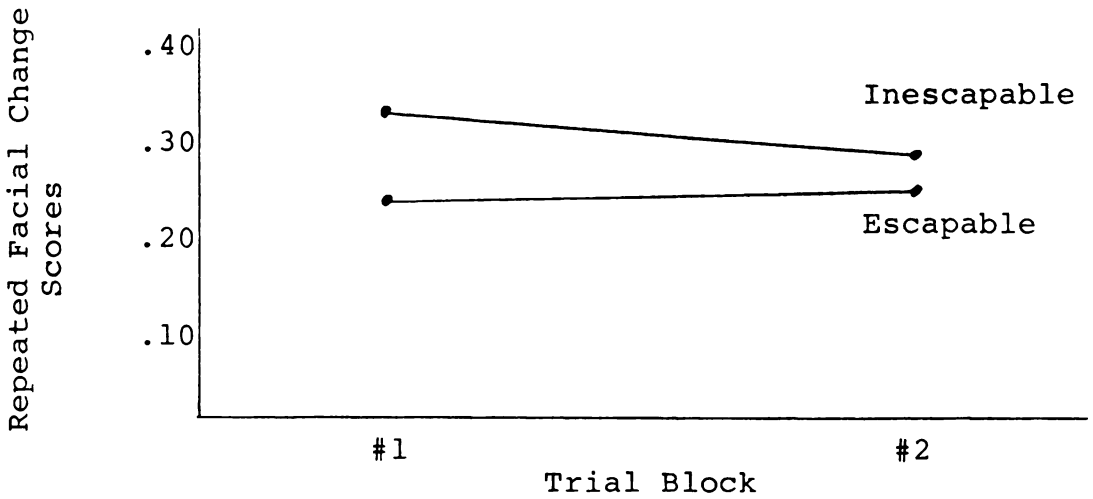


Figure 4.2. Repeated facial changes: Group means.

Table 4.3

Summary of Repeated Facial Change Analysis of Variance

Factor	F =	P =
Block #1 TR1 X TR2	7.11	.008*
Block #2 TR1 X TR2	.27	.31
Block #1 X Block #2	.77	.30
Interaction BL X TR	4.11	.029*

*Significant at alpha $p < .05$. (One-tailed tests)

TR1 = Escapable Treatment Group

TR2 = Inescapable Treatment Group

Ho_{3b}:

There will be no significant difference in the number of facial patterns displayed by the escapable and inescapable groups in trial block number two.

The alternative hypotheses are:

Ha_{3a}:

The inescapable group will display significantly fewer facial patterns than the escapable group in trial block number one.

Ha_{3b}:

The inescapable group will display significantly fewer facial patterns than the escapable group in trial block number two.

No significant differences were found between groups in the mean number of facial patterns expressed for trial block number one ($F = 1.09$, df 1/16, $p = .16$) or trial block number two ($F = .293$, df 1/16, $p = .30$). Additionally, there was no main effect for trial block ($F = 1.59$, df 1/16, $p = .11$) nor was there an interaction effect ($F = .25$, df 1/16, $p = .31$).

The relationship of treatment group means to trial block is depicted in Figure 4.3. Table 4.4 summarizes the types of patterns displayed univariate analyses.

The fourth pair of hypotheses was designed to test for the differences between groups in the duration of the display of a facial pattern. The null hypotheses are:

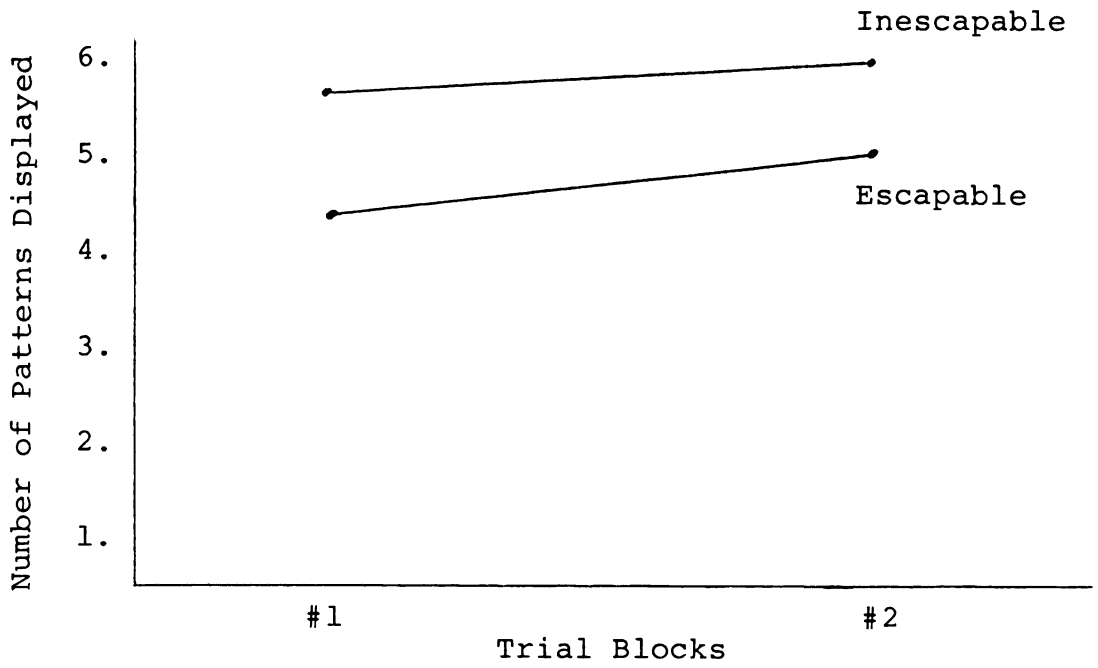


Figure 4.3. Number of facial patterns displayed: Group means.

Table 4.4

Summary of Patterns Displayed Analysis of Variance

Factor	F =	P =
Block #1 TR1 X TR2	1.09	.15
Block #2 TR1 X TR2	.293	.30
Block #1 X Block #2	1.59	.11
Interaction BL X TR	.25	.32

TR1 = Escapable Treatment Group

TR2 = Inescapable Treatment Group

(One-tailed tests)

Ho_{4a}:

There will be no significant difference in the duration of facial patterns displayed by the escapable and inescapable groups in trial block number one.

Ho_{4b}:

There will be no significant difference in the duration of facial patterns displayed by the escapable and inescapable groups in trial block number two.

The alternative hypotheses are:

Ha_{4a}:

The facial patterns displayed by the inescapable group will be of significantly shorter duration than those displayed by the escapable group in trial block number one.

Ha_{4b}:

The facial patterns displayed by the inescapable group will be of significantly shorter duration than those displayed by the escapable group in trial block number two.

No significant differences were found between groups in the average duration of facial patterns displayed for either trial block (trial block number one: $F = 2.78$, df 1/16, $p = .056$; trial block number two: $F = .027$, df 1/16, $p = .43$). Therefore, the null hypotheses Ho_{4a} and Ho_{4b} were not rejected. Further analysis revealed no main effect for trial block ($F = .024$, df 1/16, $p = .44$) nor was there an interaction effect ($F = 2.32$, df 1/16, $p = .07$).

Figure 4.4 depicts the duration scores of the two treatment groups over trial blocks. Table 4.5 summarizes the mean duration of pattern univariate analyses.

Test of Learned Helplessness

To test whether treatment with unescapable noise had an effect on later task-solving behaviors, four anagram-solving behaviors were recorded. The behaviors were: (a) response time for correct anagram solutions; (b) number of anagram trials with correct solutions; (c) number of anagram trials with incorrect solutions; and (d) number of trials terminated with the TIME UP message presented on the video screen without the first button being pressed. These measures formed the dependent variables for the four hypotheses used to test for learned helplessness. Analyses of variance were calculated with a 5% rejection region selected for all univariate F tests. Table 4.6 gives the means for all four anagram-solving measures by treatment group.

The first hypothesis tested for the effects of treatment on response time for correct anagram solutions.

Ho_5:

There will be no significant difference between the escapable and inescapable groups in mean response times for correct anagram solutions.

Ha_5:

The inescapable group will have significantly longer mean response time for correct solutions than will the escapable group.

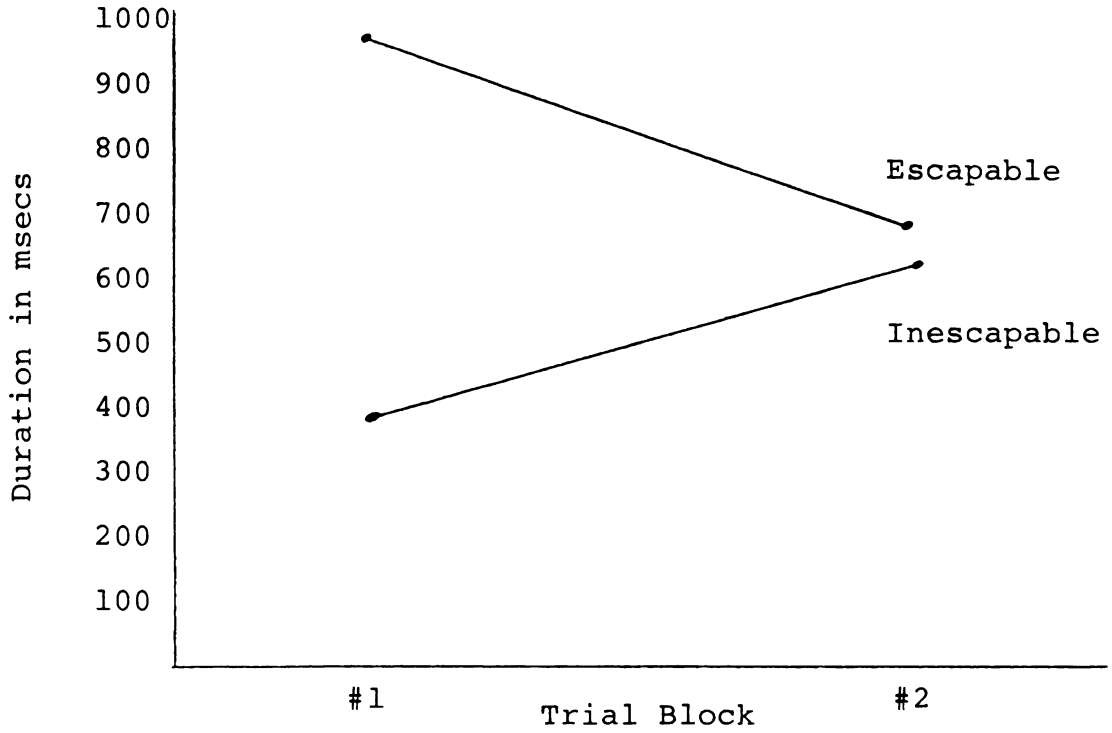


Figure 4.4. Facial pattern duration: Group means.

Table 4.5

Summary of Mean Duration of Pattern Analysis of Variance

Factor	F =	P =
Block #1 TR1 X TR2	2.78	.056
Block #2 TR1 X TR2	.027	.43
Block #1 X Block #2	.024	.44
Interaction BL X TR	2.319	.07

TR1 = Escapable Treatment Group (one-tailed tests)

TR2 = Inescapable Treatment Group

Table 4.6

Experimental Group Means: Anagrams-Solving Behaviors

	Response Time (Seconds)	Correct Solutions	Incorrect Solutions	TIME UP Solutions
Escapable Group	8.5	8.8	2.7	6.6
Inescapable Group	10.5	9.4	2.0	6.4

No significant difference between the two treatment groups in regard to mean response times for correct anagram solutions was observed ($F = .49$, df 1/16, $p = .25$). Thus, the null hypothesis was not rejected at the $p < .05$ significance level.

The second hypothesis tested treatment effects on the ability to correctly solve the anagrams.

Ho_6:

There will be no significant difference between the escapable and inescapable groups in the number of anagram trials with correct solutions.

Ha_6:

The inescapable group will have significantly fewer trials resulting in correct solutions than will the escapable group.

There was no significant difference between groups in number of correct anagram solutions ($F = .06$, df 1/16, $p = .44$). Thus, the null hypothesis was not rejected at the $p < .05$ level of significance.

The third hypothesis tested treatment effects on the number of anagram trials with incorrect solutions.

Ho_7:

There will be no significant difference between the escapable and inescapable groups in the number of anagrams trials with incorrect solutions.

Ha_7:

The inescapable group will have significantly more trials resulting in incorrect anagrams solutions than will the escape group.

No significant difference between groups was found in this measure of anagram-solving behaviors ($F = .41$, df 1/16, $p = .27$). The null hypothesis was not rejected at the $p < .05$ level of significance.

The last hypothesis tested for differences between groups in the number of anagrams trials terminated with the TIME UP message presented on the video screen.

Ho_8:

There will be no significant difference between the escapable and inescapable groups in the number of trials terminated with the TIME UP message presented on the video screen.

Ha_8:

The inescapable group will have significantly more trials terminated with the TIME UP message presented on the video screen than will the escape group (response time = 45 seconds without first button being pressed).

There was no significant difference between groups for this variable ($F = .01$, df 1/16, $p = .46$). The null hypothesis was not rejected at the $p < .05$ level of significance.

Summary

Hypotheses were tested regarding the effect of treatment with escapable and inescapable noise upon facial expression emitted during a subsequent anagrams task. The dependent variables were based on electromyogram recordings from four facial sites: the frontalis, mentalis, masseter, and depressor facial muscles. The measures derived from the electromyograms were: (a) number of changes of facial expression (facial lability); (b) number of repeated facial changes; (c) number of categories of expressions exhibited, and (d) average duration of an expression. The data were analyzed in two trial blocks of 10 anagram trials each. The null

hypotheses were tested using univariate analysis of variance with a 5% rejection region chosen for all univariate tests. Analyses revealed that the unescapable group exhibited a significantly greater number of changes of facial expression ($F = 4.56$, df 1/16, $p = .023$) and repeated facial changes ($F = 7.11$, df 1/16, $p = .008$) during the first 10 anagram trials. No significant differences were found during the first trial block for number of categories of patterns displayed ($F = 1.09$, df 1/16, $p = .15$) nor for average duration of expression ($F = 2.78$, df 1/16, $p = .056$). During the second trial block, no significant differences were found between the treatment groups on any of the facial measures (changes of expression: $F = .66$, df 1/16, $p = .28$; repeated changes: $F = 2.70$, df 1/16, $p = .31$; patterns displayed: $F = .293$, df 1/16, $p = .30$; duration: $F = .027$, df 1/16, $p = .43$).

There were no main effects for trial block and only one significant trial block-treatment interaction effect; that was for repeated facial changes ($F = 4.11$, df 1/16, $p = .025$).

Additional univariate analyses of variance were performed to determine if treatment had an effect on subsequent anagram task-solving behaviors. No significant differences were found between the treatment groups on the four anagram-solving variables. They were: mean

response time for correct solution (F = .49, df 1/16, p = .25); number of correct solutions (F = .06, df 1/16, p = .44); number of incorrect solutions (F = .41, df 1/16, p = .27); and number of TIME UP trials (F = .01, df 1/16, p = .46).

CHAPTER V

SUMMARY, CONCLUSIONS, AND DISCUSSION

In this chapter, the study is summarized and conclusions based upon the data analyses are presented, followed by a discussion relating the results of the study to facial affect theory and learned helplessness theory.

Summary

Early in his career Freud (1899) claimed, "as an indisputable fact," that all adult psychoneurotic symptoms were based on the re-experiencing of repressed "childhood sexual wishful impulses" which had been maintained by the transformation of the impulse-related affects (p. 645). Since that time the repeated use of transformed emotional behavior has been variously seen as a symptom, cause, or attribute of psychological maladjustment. Fenichel (1945) summarized the psychoanalytic view of affect transformations by noting that the defenses against affects not only transform affects but invariably lead to rigid patterns of affect expression that are symptomatic of a person's psychopathology.

Recently, Loeb (1966), Haggard and Isaacs (1966), and Hinds (1976) have noted an affect transformation on the faces of psychotherapy clients which miniaturizes and combines affect to form an important part of the clients' symptomatic behavior. The nature of the transformation is the compressing and combining of single affects over very short (two seconds or less) time spans. Kell and Mueller (1966) termed this compressing and combining of affect "compacted affect." The dynamics of compacted affect relate to the temporal reduction of the experience of one affect by the expression of another. The purpose of this transformation is hypothesized to be the termination or avoidance of unwanted affect.

In addition to these clinical impressions, Tomkins (1962-1963), Ekman (1971), Jacobson (1967), and Izard (1971) have offered theoretical models of transient affect behavior that coincide closely with the clinical observations.

Although psychological clinicians and theorists have suggested that compacted affect serves a defensive function that helps maintain maladaptive behavior, little research has been conducted to determine under what conditions and to what degree this affect transformation takes place.

The purpose of this study was to test for the effects of uncontrollable task outcomes on transient

changes of facial expression. A secondary purpose of the study was to explore the use of electromyograms in the measurement of transient facial expression.

To test for the effects of uncontrollable outcomes on facial expression, two groups of subjects were treated with either a series of uncontrollable or controllable tones. One group of subjects could not escape the repeated presentation of a loud tone (inescapable/learned helplessness group); the other (escape group) could. This design format, using the inescapable and escapable treatment groups from Seligman's learned helplessness "triadic" design, was chosen because learned helplessness following treatment with uncontrollable outcomes had been linked theoretically and empirically to depression (see Seligman, 1975, Chapter II). After treatment with the tone, both groups were given the task of trying to solve 20 single-solution anagrams. During the anagram-solving task, subjects were monitored for facial behavior. Data derived from facial electromyograms (EMG) taken from sites above the frontalis, masseter, depressor, and mentalis facial muscles were used to test for the effects of treatment on transient changes of facial expression.

Eighteen subjects who were students at Michigan State University or Lansing Community College volunteered to participate in the study. Subjects were randomly

assigned to groups and run individually. The subjects in the two groups were paired so that each pair of subjects received identical instructions and amounts of noise. To measure transient changes of facial expression, pairs of Beckman miniature Ag/AgCl surface electrodes were placed above the four facial sites. Electromyograms were taken six seconds before the beginning of each anagram trial. The EMG recordings were computer-sampled at 250 samples per second. The EMG voltages from each site were integrated over each 200-msec period then transformed to Z-scores and ranked in order of greatest positive change from resting baseline scores. The resulting 24 possible rank orders were termed facial "patterns." The following facial measures were derived from the integrated and ranked EMG data: (1) facial lability (FL); (2) repeated changes of facial expression (RFC); (3) "patterns" of expression displayed; and (4) duration of expression. To determine if there were different stages of emotionality during the anagrams task, the resultant data were divided into blocks of the first 10 and second 10 anagram trials.

Based upon facial affect theory, which suggests that people under depressive conditions will compact and combine their expressions of affect, it was hypothesized that subjects in the inescapable group would express a greater number of changes of facial expression, repeated

changes of facial expression, fewer facial patterns, and would exhibit expression of shorter duration than escapable subjects. Analysis of variance was used to analyze the data. A 5% rejection region was chosen for all univariate tests.

To determine whether treatment with escapable and inescapable noise had a behavioral effect on subsequent task-solving ability (produced a state of learned helplessness), four anagram-solving behaviors were recorded. They were: (1) response time for correct solution, (2) correct solutions, (3) incorrect solutions, and (4) time-up trials with no solution attempted. It was hypothesized, based on learned helplessness theory, that inescapable subjects would have longer response times, fewer correct trials, and a greater number of incorrect and time up trials. Analysis of variance was used to analyze the data. A 5% rejection region was chosen for all univariate tests.

Effects of Treatment on Facial Expression

Univariate F-tests were calculated to determine if there were differences between the escapable and inescapable treatment groups in regard to facial lability, repeated facial changes, patterns of facial expression, and duration of facial expression while trying to solve a series of anagrams.

Lability. It was found that subjects treated with inescapable noise displayed significantly more changes of facial expression (FL) during the first 10 anagram trials ($p < .05$) than did subjects treated with escapable noise. There was no significant difference found between the treatment groups during the second 10 anagram trials. There was no main effect for trial block nor was a trial block X treatment interaction found.

Repetition. During the first trial block, subjects treated with inescapable tones repetitively used sequences of expression (RFC) more often than did subjects treated with escapable noise ($p < .05$). No difference was found during the second trial block. There was no main effect for trial block, but there was a significant ($p < .05$) trial block X treatment interaction.

Patterns. During each of the trial blocks, subjects treated with inescapable noise were not significantly different from subjects treated with escapable noise in regard to the variety of patterns of expression displayed. There was no main effect for trial block or interaction effect found.

Duration. The mean duration of a facial expression displayed by the inescapable group was not significantly different from those displayed by the escapable

group during either trial block. There was no main effect for trial block or trial block X treatment interaction effect found.

Effects of Treatment on Anagram-solving Behaviors

Univariate F-tests were calculated to determine whether there were differences between the inescapable and escapable groups in regard to the following anagrams task behaviors: response time for correct solutions, correct solutions, incorrect solutions, and "TIME UP" trials. Subjects treated with inescapable noise did not significantly differ ($p > .05$) from subjects treated with escapable noise in the time taken to solve the anagrams, nor in their number of correct, incorrect, and "TIME UP" trials, indicating that over the 20 anagram trials, the treatment groups did not differ in the degree of learned helplessness behavior displayed.

Conclusions and Discussion

The results of the analyses indicate that prior lack of control over task outcomes (the variable believed to be responsible for inducing learned helplessness) did significantly effect some facial behaviors but did not significantly effect subsequent task-solving ability.

Based on the results of the study, three general conclusions were made: (1) EMG measures of facial changes were found capable of discriminating between the facial

activity of the treatment groups, suggesting that facial EMG may be a useful tool in the quantifying of compacted affect behavior; (2) the facial change findings tend to support the predictions based on compacted affect theory, suggesting that levels of compacting are related to previous painful experiences; and (3) the lack of behavioral differences found on the anagram-solving measures calls into question the helplessness induction procedures used in this study and more importantly the assumptions underlying the helplessness-inducing theory itself. These conclusions will be discussed in the following pages.

The Facial Behaviors

The most important findings of this study are that during the initial stages of the anagrams task subjects treated with inescapable tones exhibited significantly more changes of facial expression and repeated changes of facial expression than did subjects treated with escapable tones. These two findings have implications for facial affect theory. These implications will be discussed in the following paragraphs.

Facial expression of compacted affect is believed to have an important effect on human motivation and behavior (Tomkins, 1962; Kell & Mueller, 1966; Haggard & Isaacs, 1966; Loeb, 1966; Jacobson, 1967; Izard, 1971; Hinds, 1976). These authors hypothesize that adaptive behavior is interferred with by the repetitive expression

of sequences of compacted affect that serve as a defense against re-experiencing affect associated with prior painful events. The findings that after uncontrollable tones inescapable subjects expressed a greater number of changes of expression and repeated changes of expression than escapable subjects lend themselves to the support of the part of the hypothesis that suggests that compacted affect is a defense against re-experiencing emotion associated with painful events. (The first part of the hypothesis--that compacting interferes with adaptive behavior--will be discussed in the "anagram-solving behavior" section.)

To elaborate, in this study inescapable subjects treated with uncontrollable aversive tones showed initially (first trial block) heightened scores for facial lability and repeated facial changes when compared to the escapable subjects; but they lowered their levels of compacting following the experience of being able to control the outcomes of the first anagrams trial block, while the escapable group showed the opposite tendency. One interpretation that can be given to these results is that the direction of change in levels of facial compacting followed the direction predicted by compacted affect theory. Uncontrollable aversive outcomes were followed by comparatively heightened levels of compacting. Then after experiencing controllability during the first trial block of the anagrams task, differences subsided.

The finding that inescapable subjects did not significantly differ from their escapable counterparts in the number of categories of expressive patterns displayed suggests that the uncontrollability of an aversive stimulus does not inhibit the variety of expressions displayed in future situations that are similar to the original aversive situation. This finding fails to support the theoretical assumption that compacting is associated with a limited number of categories of expression and with any assumed resultant psychological debilitation.

This finding would also fail to support Seligman's assumption that the state of heightened emotionality following uncontrollable events consists primarily of one category of emotion, i.e., fear. In this study, subjects given uncontrollable outcomes generated greater transience and repetitive changes of EMG but did not exhibit a reduced number of patterns of expression when compared with controllable subjects. This suggests that no single type of expression dominates during periods of heightened levels of transience.

This interpretation could be misleading. The possibility exists that even if both groups displayed a similar mean number of affect patterns, subjects in either group could have used one pattern 90% of the time and used the other patterns 10% of the time, while the other group used all patterns an equal number of times. The

repeated facial change comparisons indicate that the inescapable group did, in fact, use particular pattern sequences significantly more often than did the escapable group. Thus, the theoretical position may need to be adjusted so as not to suggest a limited emotional scope but a limited variability of expression within that scope.

Seligman's explanation of the etiology of depression fits the overall results of the facial analyses. Seligman states:

> When a traumatic event first occurs, it causes a heightened state of emotionality that can loosely be called fear. This state continues until one of two things happens: if the subject learns that he can control the trauma, fear is reduced and may disappear altogether; or if the subject finally learns he cannot control the trauma, fear will decrease and be replaced with depression. (1975, pp. 53-54)

The results of this study indicate that a state of heightened emotionality, comprised of repetitive sequences of compacted affect, was greater for those treated with an uncontrollable traumatic stimulus. The heightened facial lability and repeated facial change scores obtained during the first trial block by those treated with inescapable noise (the traumatic event) would be consistent with Seligman's etiological theory. The fact that significant differences were not found during the second trial block also seems to support Seligman's contention that if the subject learns he can control the trauma, the heightened state of

emotionality is reduced. During the first trial block, subjects did have the chance to control the trauma and went on to reduce their expression of facial changes and repeated facial changes in the second trial block.

Seligman's contention that the "heightened state of emotionality" could "loosely be called fear" needs to be explored further. The muscles measured in this study are not commonly associated with fear but are associated with the expression of grief, sadness, and distress. Still, it may be that fear is an integral part of the compacting-sequencing process. Along a similar vein, Hinds (1976) has suggested that compacted affects are "interfaced with fear"; this, however, needs further study.

An implication of the results of this study is that in order to understand the emotionality accompanying uncontrollable traumatic events and subsequent generalized behavior, researchers may need to study the compacting and sequencing of affect, as well as the affect content accompanying such traumatic situations.

Anagram-solving Behavior

The results of the anagram-solving comparisons indicate that the groups did not differ in their degree of learned helplessness-depression during the anagrams task. One of the original goals of this study was to provide evidence that would help determine what, if any,

relationship exists between depression and compacted facial affect. But the lack of significant group differences on the anagram-solving measures permits only speculative discussion about the relationship between depression and facial expression. Necessarily left unanswered is the original research question that asked whether depression is associated with an increase (as suggested by the compacted affect literature) in the expression of compacted patterns of facial affect. The following discussion will focus on possible explanations for the learned helplessness findings, including a critique of the standard learned helplessness paradigm.

Eckelman (1976) states that for helplessness-inducing procedures to be effective, they need to meet the following conditions: (1) subjects expect that they will be able to control the outcomes, (2) subjects are exposed to a high amount of helplessness training (uncontrollable outcomes), and (3) subjects believe that the outcome is important. These conditions may not have been met in this study.

This study's procedures, while essentially similar, differed significantly from what could be described as a standard helplessness-inducing paradigm and could have resulted in a softening of treatment effects. A common procedure in learned helplessness studies (Seligman, 1975) is for the treatment groups to initially be given the task

of trying to solve a series of task trials with one solution-behavior, capable of being learned, that will solve all trials. For instance, during treatment with tone, it is usually necessary to discover only one solving-behavior, e.g., one series of button presses. For this study, it was necessary to solve seven different patterns of button presses in order to terminate all 20 tones. This was planned to give subjects a "real life" and meaningful series of controllable or uncontrollable events in the belief that this would result in stronger treatment effects.

The reverse may have been true. Inescapable subjects may not have expected that they could control the outcomes of the latter tone trials. Inescapable subjects may have initially believed they could control the tone but because the task (the number of button presses necessary to solve the task) changed often (depending upon the success of the paired escapable subject), they may have come to believe that they simply did not have enough chances to learn the controlling behavior. In addition, the inescapable subjects were given the exact stimulus duration of tone as the preceding escapable subject had received for each trial. This resulted in tone of very short duration on many trials (where escapable subjects had found the sequence of presses) and could have resulted in a belief of no control over outcomes because of a lack of reasonable time to solve the task.

The combination of multiple solving-behaviors and short time periods in which to solve the task could have left inescapable subjects with the feeling that it was unreasonable to expect that anyone could have gained control over all outcomes. Thus, rather than concluding that they were unable to gain control, they could have concluded that their initial evaluation of expected control was erroneous. In other words, they may have felt "set up" rather than "helpless." This would have violated condition number one (expected control) of an effective helplessness-inducing procedure. Additionally under these conditions, 20 tone trials may not have been enough uncontrollable outcomes (Condition #2) to create generalizable feelings of "helplessness."

Another and perhaps more telling interaction of this "lessening" of treatment effects calls into question the underlying assumptions of the learned helplessness paradigm. That is that helplessness induction procedures may not be producing behavioral deficits as a result of feelings of helplessness, but perhaps what is witnessed is a motivational deficit leading to withdrawal from transgressor (in this case the experimentor) associated requests for behavior that could be related to feelings of power defiance or other reactive feeling states. In this study pilot inescapable subjects were quizzed regarding their feelings following treatment with a

standard (one relatively simple series of button presses given repetitively) helplessness-inducing task.

This procedure was changed to the one used in this study when pilot subjects reported that they withdrew from the (anagrams) task because of feelings of "being tricked," or "mistrust" and not because of helpless feelings. The procedures eventually used in this experiment were intended to give the inescapable subjects repeated controllable tasks that would be experienced as potentially real and honest as well as controllable.

Thus, the helplessness-inducing procedure utilized in this study was just as uncontrollable as the standard procedures but had a lessened impact perhaps because it reduced mistrust of the experimentor and not because it produced reduced levels of helplessness feelings (in fact, it would seem plausible to assume it caused more feelings of helplessness).

The point being made is that there is reason to be concerned with the underlying assumptions that suggest that behavioral deficits result from feelings of helplessness following uncontrollable events.

The tone task-solving procedures may also have had an effect on the escapable group subjects that could have led to a lessening of the differential effects of treatment. Most of the escapable group subjects

experienced initial success during the tone task, but this always led to an increasingly difficult task (a lengthier series of presses), which led to additional failures. This may have discouraged the transferring of task-solving behaviors to the anagrams task. In other words, these subjects may have been subjected to helplessness-inducing conditions. They believed they had control over outcomes (Condition #1), and they often experienced repeated and increasing amounts of negative outcomes which may have been perceived as uncontrollable as the task became more difficult (Condition #2).

Another possible explanation of the lack of effects found would be that the anagram-solving task was different in important ways from previous studies using anagrams as a test task and that this affected the results of the anagrams task. For example, in most helplessness studies using anagrams as the test task, the subject has the full prescribed time period to try to solve the anagrams, regardless of how many trials and errors were made in an effort to solve the anagram. In this study, the subject had but one chance: once the subject pushed the fifth button spelling out a five-letter answer, the trial was over. This may have had a differential effect upon the treatment groups' subsequent solving-behaviors; i.e., it may take a larger number of trial and error/success

responses with feedback than the test-task afforded before the effects of a helplessness-inducing treatment can take hold.

This analysis "fits" the behavior of what Seligman termed "the paradigmatic learned helplessness finding." Seligman states that when a dog pre-treated with inescapable shock was placed in a shuttle box from which it could escape,

> . . . it ran around frantically for about thirty seconds. But then it stopped moving; to our surprise, it lay down and quietly whined. After one minute of this we turned the shock off; the dog had failed to cross the barrier and had not escaped from shock. On the next trial, the dog did it again; at first it struggled a bit, and then, after a few seconds, it seemed to give up and to accept the shock passively. On all succeeding trials, the dog failed to escape. (1975, p. 22)

Thus, the dog had (and perhaps needed) the chance to make "frantic" adjustments to the environment before the effects of the previous helplessness-inducing treatment could be transferred to the new situation.

It is interesting to speculate as to whether freedom of frantic evaluation and reaction may be a necessary condition for the induction and transferring of learned helplessness behavior. If this were so, it would have important clinical implications. That is, controlling the conditions that allow for quickened evaluation and reaction may be, at times, a more efficient approach to countering the effects of prior uncontrollability than retraining the organism to believe that it has control.

Limitations

This study is subject to a number of limitations which affect its generalizability.

One limitation to the generalizability of the study is based on the fact that no other means for measuring transient facial expression, other than electromyograms, were used in this study. Therefore, generalizations to other methods of determining facial expressive behavior (e.g., self-reports, introspection, visual observations, and judgments based on visual recordings) are unwarranted. (Jacobson, 1967, and Schwartz et al., 1973, 1974, found that subtle facial EMG activity was generally not observable visually nor recountable introspectively without extensive training.) Additionally, since only four facial muscle sites (of more than 100 muscle sites) were monitored with electromyograms, generalizations to other surface muscle sites, or the "face" per se, is unwarranted at this time.

Subjects in this study were college students who volunteered to participate after they had been informed of the study's general purpose. They were told that it was a study of psychological and physiological activity during problem-solving situations, that physiological measures would be taken, what types of tasks would be expected of them; and they were given a chance to hear the "mildly unpleasant tone" before they were asked to

make a final decision about participation. Thus, this was a highly restricted subject sample. Generalizations to other populations would be questionable judgment.

Also, it must be noted that laboratory "staged" uncontrollable events often bear little resemblance to their "real-life" counterparts, so generalizing from laboratory conditions to in vivo conditions is questionable.

A design oversight and the omission of an additional analysis limited information that could have been gathered in this study. The differential trial block analyses performed on the facial behaviors (two trial blocks) and the anagram-solving behaviors (one block) limited interpretative direct comparisons between the behaviors. And the omission of a test for the simple effects of trial block on the facial behaviors of both groups precluded discussion about the significance of the changes observed.

Finally, a threat to internal validity could have been introduced when all EMG facial recordings were screened for major facial reactions such as yawns, eye blinks, and head movements. When such movements were observed, the six-second data sample was thrown out. This could have resulted in a differential loss of transient facial behavior from the groups. For example, it was assumed the yawns were random displays of nonexpressive

behavior, but it could be that one or the other of the groups was yawning to cover up displays of emotion stimulated by the pretreatment.

Implications

Psychological clinicians have been vocal about the importance of compacted affect behavior to mental health. They believe that the recalcitrance of patterns of compacted affect makes treatment of maladaptive behavior extremely difficult. The inability of clinicians to observe transient behavior and identify exactly what affects are being displayed and in what order interferes with their diagnosis and behavior change efforts.

Continued exploratory research in the following three areas could give clinicians needed information about transient affect behavior.

1. Electromyography has been claimed by Schwartz (1974) to be a sensitive and objective means for quantitative and qualitative measurement of subtle facial adjustments. This research supports that claim and goes further: not only is electromyography a means of measuring subtle-covert facial adjustments, it also provides a means for measuring transient adjustments of facial expression.

Further exploratory research into the use of electromyograms seems warranted. Such study might be aided by a cross-validation of electromyographically measured expression to affect with other instruments,

such as high-speed film and videotape. It would seem that high-speed film could be used to identify the subtle and covert facial configurations displayed at transient levels, while electromyograms could measure specific patterns of muscle activity associated with transient expressions.

The following comments relate to the facial EMG procedures used in this study. The procedures were exploratory in the sense that they broke new ground in the study of facial EMG activity. The discriminations found between the treatment groups suggest that the procedures used in this study deserve more attention and support Schwartz's work and conclusions about the usefulness of facial EMG in the study of subtle facial affect behavior.

One suggestion for refining the measure is that great attention needs to be given to observing and eliminating interfering EMG artifacts such as eyeblinks and yawns. For example, in efforts to measure the surface EMG activity above the corrugator muscle it was impossible to eliminate such artifacts from the recordings, calling into question the usefulness of using the corrugator muscle as a surface recording site (as Schwartz, 1973, 1974, has done in his studies of facial EMG).

2. The study of the emotionality accompanying the induction, generalization, and reversal of maladaptive

behavior is needed. The learned helplessness paradigm (whether it is helplessness or some other maladaption that is manifested) seems well suited for the exploratory study of emotionality during traumatic conditions. Not only does it allow for the study of emotion present under such conditions, but it offers the opportunity to study the emotional process accompanying "helplessness" induction, generalization, and reversal. This type of "time series" analyses would seem ideally suited to garner information useful to clinicians who must deal with the effects of such debilitating learning processes daily.

The results of this study indicate that "helplessness-emotion" studies would be aided by the following considerations: (a) that the more "real-life" the helplessness-inducing treatment is, the more attention needs to be given to insuring the following conditions are met: initial belief in the controllability of the outcomes, large amounts of uncontrollable outcomes, and strong meaning attached to the ability to control outcomes; (b) since emotional reactivity to uncontrollable events theoretically occurs in stages, the research design needs to incorporate means to measure the stages of emotionality following helplessness induction; (c) that pre and post-testing (or the addition of an untested control group; this option would amount to Seligman's "triadic" design) are needed to determine the direction of change in

transient emotional behavior following uncontrollable events. Without this change in design, it cannot be determined if inescapable subjects are demonstrating mitigated reductions or accented additions of transience levels following uncontrollable events; (d) that an intensive design may be a more economical approach to exploring the parameters of emotionality following uncontrollable events than are group designs. An intensive (N=1) study could provide detailed descriptive material about the emotional process accompanying traumatic learning situations that could guide future research efforts.

3. Finally, clinicians need to know more about the meaning given to transient affect by those who experience it. Emotion has been hypothesized to be a way in which humans evaluate their environment and make judgments about what action to take. The possibility that compacted affect is accompanied by compacted evaluation, judgment, and action needs to be explored. The study of the phenomenology of compacted affect could supply information about the meaning of this segment of affective behavior and supplement the findings gained through observational methods.

APPENDICES

APPENDIX A

SUBJECT SIGN-UP SHEET

APPENDIX A

SUBJECT SIGN-UP SHEET

Dear student:

We are looking for students to participate in a research study into problem-solving behavior. We are interested in understanding psychological and physiological changes that may accompany problem solving. The experiment consists of two tasks: an instrumental task (listening and responding to noise) and a cognitive task (observing and rearranging mixed printed symbols). The instrumental task will last about 15 minutes and the cognitive task about 30 minutes. The entire study will take about 90 minutes.

Some physiological responses will be recorded during the problem solving (heart rate, pulse, breathing along with forehead, chin, and cheek muscles). When you finish, we will show you your physiological recording and discuss it with you. If you can participate you will be helpful to us in our efforts to better understand problem-solving behavior. For those of you who will be conducting your own research in the future you may find the procedures and the physiological recordings of added interest.

If you would like to participate please leave your name, open time periods and the dates you could participate, and I will contact you.

_____
Name

_____
Phone no.

_____
Times and dates available

Sincerely,

Roger Landvoy
(Counseling Psychology Doctoral Candidate, Tel. 351-1747)

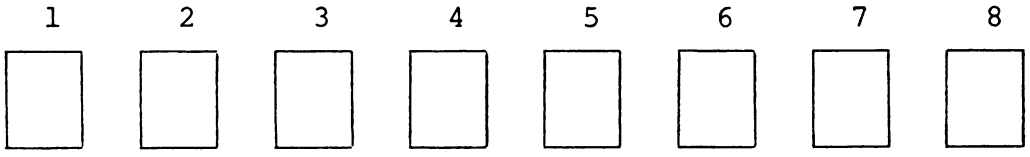
William C. Hinds
(Professor, Counseling and Personnel Services)

APPENDIX B

DIAGRAM OF BUTTON BOX

APPENDIX B

DIAGRAM OF BUTTON BOX



Buttons numbered one and two were operable during the tone task and buttons numbered one through five and number eight were operable during the anagrams task.

APPENDIX C

CORRECT SEQUENCE OF BUTTON PRESSES FOR TONE TASK

APPENDIX C

CORRECT SEQUENCE OF BUTTON PRESSES FOR TONE TASK

(a) 1, 2, 2, 1

(b) 2, 1, 1, 2

(c) 1, 1, 1, 2, 1

(d) 2, 2, 2, 1, 2

(e) 1, 1, 2, 2, 1, 1

(f) 2, 2, 1, 1, 2, 2

(g) 1, 1, 2, 2, 1, 1, 2

APPENDIX D

ANAGRAMS

APPENDIX D

ANAGRAMS

Word	Anagram				
	1	2	3	4	5
(a) APRON -	R	O	P	N	A
(b) OPIUM -	I	U	P	M	O
(c) WAGON -	G	O	A	N	W
(d) MUSIC -	S	I	U	C	M
(e) NOBLE -	B	L	O	E	N
(f) GIANT -	A	N	I	T	G
(g) BATON -	T	O	A	N	B
(h) ROACH -	A	C	O	H	R
(i) BATCH -	T	C	A	H	B
(j) PEONY -	O	N	E	Y	P
(k) HABIT -	B	I	A	T	H
(l) PATIO -	T	I	A	O	P
(m) FLOUR -	O	U	L	R	F
(n) COUGH -	U	G	O	H	C
(o) FAULT -	U	L	A	T	F
(p) POUND -	U	N	O	D	P
(q) UNCLE -	C	L	N	E	U
(r) PANIC -	N	I	A	C	P
(s) HUMAN -	M	A	U	N	H
(t) CLERK -	E	R	L	K	C

(Adapted from Tressalt and M. S. Mayzner, 1966, Psychonomic Press.)

APPENDIX E

DEPARTMENTAL RESEARCH CONSENT FORM

APPENDIX E

DEPARTMENTAL RESEARCH CONSENT FORM

Michigan State University
Department of Psychiatry

1. I have freely consented to take part in a scientific study entitled: Psychophysiology of Problem Solving being conducted under the supervision of:

   Dr. Lawrence Van Egeren

   Academic Title: Associate Professor

2. The study has been described to me and I understand the description that has been given and what my participation will involve.

3. I understand that I am free to discontinue my participation in the study at any time without penalty.

4. I understand that the results of the study will be treated in strict confidence and that I will remain anonymous. Within these restrictions, results of the study will be made available to me at my request.

5. I understand that my participation in the study does not guarantee any beneficial results to me.

6. I understand that, at my request, I can receive additional explanation of the study after my participation is completed.

7. I have listened to a sample of the tone that will be used in the study and after hearing the tone agree to continue participation.

Signed: _____

Date: _____

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