EFFECTS OF MANIPULATED FACIAL EXPRESSIONS ON SUBJECTIVE AND PHYSIOLOGICAL INDICES OF EMOTION

by

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B.A., University of British Columbia, 1980

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Psychology

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SIMON FRASER UNIVERSITY

April, 1986

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Effects of Manipulated Facial Expressions on Subjective and Physiological Indices of Emotion

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ABSTRACT

This study examined the effects of manipulated expressive behavior on subjective and physiological responses. Although facial expressions are considered to be an important component of emotional experience there are conflicting positions regarding the relationship between an emotion and its overt expression. The discharge model of emotion posits an inverse relationship between facial display, physiological, and subjective responding. Conversely, the arousal model predicts that expressiveness, subjective responses, and internal reactivity are positively related.

The present study indicated that when subjects were induced to "frown" and "smile", they reported feeling more angry when frowning and more happy when smiling. These findings are in accord with the arousal model prediction that facial expressions influence the subjective experience of emotion. However, this effect was most prominent for the frown expression. This raises the possibility that individuals may evaluate facial cues from emotion-prototypic muscle configurations differently, responding to some but not to others.

Manipulations of facial expressions, in the absence of emotion-eliciting stimuli, did not produce increases or decreases in any measure or physiological responding. These findings do not support predictions from either the discharge or arousal model of emotion. However, the results do suggest that

while facial behavior may be sufficient to produce changes in subjective experience, physiological responding requires a more potent induction than provided by expressive behavior alone.

ACKNOWLEDGEMENTS

It is this part of my thesis that gives me the most pleasure to write as I have the opportunity to acknowledge the support of those who helped to make the completion of this project possible.

I would like to thank my advisory committee, Dr. Christopher Davis, Senior Supervisor, Dr. James Marcia, and Dr. Kenneth Craig, External Examiner, for the support and encouragement offered at various stages of this thesis.

A special acknowledgement and heartfelt thanks to Dr. Ray Koopman who, in giving so patiently of his time, brought me to the point where I understood and felt confident with the data analyses.

Many thanks to Howard Gabert, Malcolm Toms, Wayne Tressel, and Frans Vanlakerveld, without the assistance and moral support of the Department's outstanding technical and support staff this thesis would never have been completed.

To my fellow graduate students, thanks for the support, encouragement, smiles, and hugs that carried me through those "rough times". A special thanks to Con Rea (Ph.D) whose friendship, humor, and cravings for pasta helped make this process fun.

To my family and friends, thanks for the encouragment, love, and patience given over the years - it made all the difference. A very special acknowledgement and many thanks to Brenda Gerhard who willingly gave of her time to help with this thesis by coding my videotapes, the dinner's on me.

Finally, to my husband Jim Tysoe, this thesis is dedicated to you for all that's been said and for what remains to be said in private.

DEDICATION

To Jim, for his love.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure **Page**

CHAPTER I

INTRODUCTION

There are conflicting positions regarding the relationship between an emotion and its overt expression. One view, which is termed the "discharge model", loosely derived from psychoanalytic theory, posits that expressive behavior attenuates emotional experience such that facial display and physiological responding are inversely related (Jones, 1950). An opposing theoretical position, which can be termed the "arousal model" (Gellhorn,1964; Tomkins,1980; Izard,1977) makes the opposite prediction. The arousal model holds that emotional experience is, in part, a result of feedback from the facial musculature and predicts that expressiveness and internal reactivity will be positively related. There is empirical support for both the discharge model (Buck, Savin, Miller & Caul,1972; Buck, Miller & Caul,1974; Notarius, Wemple, Burns & Kollar,1982) and the arousal model (Lanzetta, Cartwright-Smith & Kleck,1976; Zuckerman, Klorman, Larrance & Spiegel,1981; Ekman, Levenson & Friesen,1983). In the face of such differences further exploration of the role that facial expression plays in the experience of emotion is warranted.

Theoretical Background

Discharge Model

The discharge model is derived from psychoanalytic principles. Rapaport (1953,1961) pointed out that the Freudian concept of emotion is unclear as the term was used loosely and was prescribed different roles as the theory developed. On some occassions Freud considered affects to be *a* or *the* form of psychic energy; at other times he viewed affects as an implied attribute of other psychoanalytic concepts. After reviewing psychoanalytic and other contributions, Rapaport reached the following conclusion:

> "Of the various theories, the following theory of the mechanism of emotions emerges ... an incoming percept initiates an unconscious process which mobilizes unconscious instinctual energies, if no free pathway of activity is open for these energies - and this is the case when instinctual demands conflict - they find discharge through channels other than voluntary mobility; these discharge processes - "emotional expression", and "emotion felt" - may occur simultaneously or may succeed one another, or either may occur alone; as in our culture open pathways for instincts are rare, emotional discharges of varying intensity constantly occur ..." (Rapaport, 1961, p.37 cited in Izard, 1977).

What has become known as the 'discharge model' draws from this interpretation of emotion. In this model, emotion is viewed as a form of energy and as such must follow the basic dynamics of energy conservation (Notarius et al.,1982). As a person becomes emotionally aroused, this arousal must be discharged. There are two discharge processes: overt facial behavior ("emotional expression") or physiological reactivity ("emotion felt"). The psychoanalytic position, as reported by Rapaport, allows for the two discharge processs to occur either simultaneously, in succession, or independently. However, proponents of the discharge model seem to contend that the most frequent occurence is that the processes are expressed independently of one another. This view is likely based upon the psychoanalytic position that as a result of cultural/social influences the majority of persons have developed unconscious defense mechanisms which prohibit free expression of instincts. Affect, blocked from discharge through both processes, is discharged either directly through overt expression or indirectly through internal pathways (Notarius et al., 1982).

When direct expression is blocked by the defense mechanisms, a discrepancy among overt behavioral display, self-report, and physiological reactivity is predicted (Notarius, et al., 1982). For example, repressive defense mechanisms are expected to lead to inhibited overt display of emotion, a lack of awareness of emotional response, and increased physiological responding (as the effective energy is discharged somatically). Other defense mechanisms, such as reaction formation and displacement, result in the overt display and the self-report of effect, yet they do not lead to increased physiological reactivity because emotional expression remains directed outward (Rapaport, 1953).

Lanzetta & Kleck (1970) and Buck (1980) offer an explanation for an inverse relationship between overt expressivity and physiological responding predicted by the discharge model that does not rely upon psychoanalytic principles. It is suggested that some individuals are socialized to inhibit emotionally expressive behavior. If this inhibition has been achieved primarily through the punishment of expressive activity by the socializing agents, it is likely that these individuals will have learnt not to be overtly expressive. Thus, when exposed to emotionally evocative stimuli such individuals will attenuate their expressive behavior and increase internal arousal. Although not stated, in keeping with this position is that the converse would be true of individuals whose socialization has permitted emotionally expressive behavior.

In summary, the discharge model, whether approached from the psychoanalytic or socialization perspective, postulates that verbal, facial, and physiological responses are alternative channels for releasing the emotional energy evoked by a stimulus. The model predicts that the expression of emotion through one channel results in an attenuated response in the others.

Arousal Model

Over a century ago, Charles Darwin stated that: "The free expression by outward signs of an emotion intensifies it. On the other hand, the repression as far as possible, of all outward signs, softens our emotion" (1872/1927, p.22). With this observation Darwin presented the premise which underlies the arousal model, that expressive behavior augments subjective and physiological indices of emotion. There are several theories which accept this premise and although they differ on causal priority, these various positions predict a positive relationship between facial display, self-report, and physiological indices of emotion.

Although Darwin argued that expressive behavior affects the intensity of emotion, it was actually William James who was the first to formalize this position into a theory of emotion. James (1884/1968) defined emotion as the feeling of bodily changes brought about by the perception of an exciting event. He argued that peripheral bodily changes are essential to add an emotional quality to the perception of a stimulus situation: "Bodily changes follow directly the *perception* of the exciting fact, and ... our feeling of these same changes as they occur *is* the emotion ... Without the bodily states following on the perception, the latter would be purely cognitive in form, pale, colourless, destitute of emotional warmth" (p.19; italics in the original).

James has been considered to assert that emotion is the individual's awareness of visceral sensations produced by such phenomena as a pounding heart, and interrupted or rapid breathing. However, in the original statements of his theory, James clearly felt that voluntary striate muscle activity, including facial expression, was involved in changes that resulted in the experience of emotions: "Can one fancy that state of rage and picture no ebullition of it in the chest, no flushing of the face, no dilation of the nostrils, no clenching of the teeth, no impulse to vigorous action, but in their stead limp muscles, calm breathing, and a placid face?" (1884/1968, p.23). Unfortunately, the conclusions drawn by James regarding the importance of voluntary muscle action were essentially lost by the development of a relationship between James' ideas and those of Carl Lange.

Lange (1885) took the position that emotion consisted entirely of vasomotor disturbances in the visceral and glandular organs and that secretory, motor, cognitive, and experiental factors were entirely secondary processes. As has been observed (Tourangeau & Ellsworth, 1979; Izard, 1977; Zuckerman et al., 1981) this merging of theoretical positions was unfortunate in that it obscured James' posit that muscular feedback (ie., changes in tonus, posture, and facial muscles) were important in the experience of emotions. Most subsequent writers, including major critics, attributed a solely visceral version to both authors indiscriminately in using the term "James-Lange Theory".

What became known as the "James-Lange Theory" was questioned by W.B. Cannon (1927). Cannon's major criticisms of the theory stemmed from his research which demonstrated that: (a) total separation of the viscera from the central nervous system did not alter emotional experience; (b) the viscera were too insensitive and too slow to be a source of emotional feeling; (c) the same visceral changes occur in different emotional states and in nonemotional states; and (d) artificial induction of visceral changes typical of emotions did not produce emotions.

Although Cannon's arguments and supporting evidence were very convincing, in more recent years the force of some of his criticisms have been blunted. For example, Hohman (1966) studied the reported emotional experiences of patients with spinal cord injuries and found that patients with higher spinal lesions (and thus a greater loss of bodily sensation) reported a decreased intensity in emotional experience. Simlarly, Delgado (1969) observed that a patient who had undergone a unilateral sympathectomy reported that he could no longer be thrilled by music on the sympathectomized side of his body, whereas his response on the other side was unchanged. These studies have demonstrated that visceral feedback normally plays an important role in emotional processes, although it is apparently neither necessary nor sufficient for all kinds of emotional experience or behavior (Buck,1976). In addition, Izard (1977) stated that Cannon's criticisms have no bearing on James' position that voluntary striate muscle activity plays an important role in the perception of effect.

James, by emphasizing the influence of the viscera <u>and</u> voluntary muscles in the emotive process, laid the groundwork for a search for general bodily patterns and facial expressions related to emotion. Theories which attribute special significance of the face, facial expression, and facial feedback to the experience of emotion have been put forth by Tomkins (1962,1980), Gellhorn (1964), and Izard (1974,1977).

Tomkins (1962,1980) regards the emotions as primarily facial responses. He maintains that proprioceptive feedback from facial behavior, when transformed into conscious form, constitutes the experience or awareness of emotion. Genetically inherited, innate emotion-specific programs for organized sets of facial responses are stored in subcortical areas. As the nerves of the face are more finely differentiated than those of the viscera, facial activity and feedback are much more rapid responses than that of the viscera. Visceral responses, while important, play a secondary role in emotion, providing only accompaniment for the discrete expressions of the face. According to Tomkins, a specific emotion is a specific facial expression and our awareness of that facial expression is the innately programmed subjective experience of emotion: "One does not learn to be afraid or to cry or to startle, any more than one learns to feel pain or to gasp for air" (1980, p.142).

Adhering to the position that there is an innate component to emotion, Tomkins (1980) describes what he regards as the nine primary effects and their corresponding facial displays:

> "The positive effects are as follows: first, *interest* or *excitement*, with eyebrows down and stare fixed or tracking an object; second, *enjoyment* or *joy*, the smiling response; third *surprise* or *startle*, with eyebrows raised and eyes blinking. The negative effects...: first, *distress* or *anguish* the crying response; second, *fear* or *terror*, with eyes frozen open in a fixed stare or moving away from the dreaded object to the side, with skin pale, cold, sweating, and trembling, and with hair erect; third, *shame* or *humiliation*, with eyes and head lowered; fourth, *contempt*, with the upper lip raised in a sneer; fifth, *disgust*, with the lower lip lowered and protruded; sixth, *anger* or *rage*, with a frown, clenched jaw, and red face" (p. 142-143, italics in original).

According to Tomkin's theory, the instigation of these effects is dependent upon the rate of neural firing in the central nervous system, however, it is not clear from his writings what parts of the central nervous system are expressly involved. Tomkins (1980) proposes that both positive and negative affects (startle, fear, interest) are activated by stimulation increase in the CNS, but only negative affects (distress, anger) are activated by a continuing unrelieved level of stimulation, and only positive affects (laughter, joy) are activated by stimulation decrease.

Gellhorn (1964) offers a very detailed analysis of the relationship between proprioceptive impulses from facial and postural activity and the subjective experience of emotion. He stated that: "facial, proprioceptive and cutaneous impulses seem to play an important role in facilitating the complex interactions between brain stem, limbic and neocortex which, during emotion, contribute to the variety of cortical patterns of excitation which underlie specific emotions" (p. 446). From this it is evident that Gellhorn thought the feedback from facial contractions resulted in hypothalamic-cortical excitation which, in turn, influences the subjective experience of emotion. Unlike Tomkins, Gellhorn was more cautious in attributing a strictly causal role to the sensory stimuli from the face, but did feel strongly that the face was an important regulator of emotion.

More recently, Izard (1974,1977) presented a theory regarding the influence of facial expressions in emotional experience termed 'differential emotions theory'. According to Izard, there are ten fundamental emotions: interest, joy, surprise, sadness, anger, disgust, contempt, fear, shame/shyness, and guilt. Unlike Tomkins, Izard does not feel that these emotions can be categorized as inherently "positive" or "negative", as the affect will depend upon intraindividual and person-environment interactions. Izard defines a fundamental emotion as " a complex motivational phenomenon, with characteristic neurophysiological, expressive, and experiential components" (1980, p. 167). At the neurophysiological level, a fundamental emotion is a particular, innately programmed pattern of electrochemical activity in the nervous system. The expressive component consists mainly of a characteristic pattern of facial activity, but may also include bodily responses (postural-gestural, visceral-glandular) and vocal expressions. At the experiential level, each fundamental emotion is a unique quality of consciousness (Izard, 1980). Izard emphasizes that any description of emotion, if it is to be complete, must address all three components.

According to Izard's theory, the process of emotion activation is mediated by the somatic nervous system, although once an emotion is activated it may arouse autonomic, visceral, and glandular activity. As Izard points out: "This view of emotion activation has important implications for the self-regulation of emotions, since the somatic nervous system is under voluntary control. ... if the hypothesis is correct, a person who needed to suppress anger ... should be able to attenuate the emotion either by inhibiting the expressive movements of the face and body or by relaxing the muscles involved" (1980, p. 169). Although it is postulated that facial expressions may be partially or fully inhibited, added is that the voluntary suppression of the emotional expression does not necessarily preclude the experience of the emotion since rapid "micromomentary expressions" or alternate pathways for the usual feedback pattern may still be triggered. Nonetheless, Izard feels that under certain circumstances voluntary expression control can play a role in the regulation of the emotional experience.

A variant of the facial feedback hypothesis, set within the framework of self-attribution theory, has been postulated by Laird (1974,1981,1982). Noting that the facial feedback effect was not equally strong in all individuals, Laird proposed that there were general differences between people in the kinds of information they used in identifying their own attributes. He stated that there are two quite different kinds of information available for self-perception. One kind, called "self-produced cues", arises from the individual's own actions and their effects, including expressive behavior, autonomic responses, and instrumental actions. The other, "situational cues", consists of normative information relevant to the situation, including what other people are or should be doing or feeling. In most circumstances these two sets of cues lead to the same self-perceptions, but when they do not, people will differ consistently in their response to one kind of self-perception or the other. Laird suggested that the facial feedback postulate will hold true for individuals who are most responsive to self-produced cues (eg., feel emotions consistent with their facial expressions) and not necessarily for those responsive to situational cues.

Despite the differing emphases of the various theories discussed, all accept the premise that expressive behavior augments self-report and physiological responsivity. As is evident from the brief review of theories accepting the arousal model of emotion, Tomkins, Gellhorn, Izard, and Laird place greater emphasis on the role of facial display as it relates to other indices of emotion than did James. Because of the explicit emphasis these theorists put upon brain feedback of sensations created by facial expression causing, or at least influencing, the emotion felt, these theories have become collectively known in the literature as postulating a "facial feedback theory" or "facial feedback hypothesis" (Ekman & Oster,1979; Buck,1980; Kleinke & Walton,1982; Winton, Putman & Krauss,1984).

The following section is a review of the empirical evidence that has been found in support of either the discharge or arousal model of emotions. For clarity, the review is organized according to the general experimental paradigm used.

Empirical Research

Three general paradigms have been used to examine the role of facial expression in the experience of emotion:
(a) generation of subjects' natural expressions; (b) subjects' asked to exaggerate and/or minimize their expressive reactions; and (c) muscle-by-muscle manipulation of subjects' facial expressions.

Natural Expression Paradigm

Within this general paradigm, subjects' natural expressions are elicited by exposure to emotion-provoking situations.

A number of reseachers have used this technique to examine the accuracy of decoding nonverbal communication of affect (Lanzetta & Kleck,1970; Buck et al.,1972; Buck et al.,1974). In these studies a 'sender' subject was exposed to an emotional stimulus while an 'observer' subject attempted to decode the sender's expression. The sender's skin conductance or heart rate or both were monitored throughout the stimulus presentation. The results indicated that the observer subjects were more accurate at decoding the facial expressions of sender subjects who were least physiologically reactive, whereas they were least accurate at decoding facial expressions of sender subjects who were most physiologically reactive. This implied that decoding accuracy was positively related to facial expressiveness but negatively related to physiological reactivity. These findings have been interpreted as support for the discharge model of emotions which suggests that facial display is associated with attenuated physiological responding.

A major problem with these studies is that the assessment of facial expressivity was dependent upon the measure of decoding accuracy and the implication that this measure reflects actual overt expressiveness. Thus, facial expressions were not measured independently but were confounded with another variable, decoding accuracy. As a result, it has been suggested that these studies do not provide strong empirical support of the discharge model (Notarius & Levenson, 1979).

Notarius & Levenson (1979) proposed that a more direct test of the relationship between facial behavior and physiological reactivity would require that expressivity be measured independently by trained raters. They conducted a study in which subjects were exposed to a threat of shock situation during which facial expressions, heart rate, respiration rate, and skin conductance were recorded. Subjects were designated as "inhibitors" or "expressors" based upon a rating of the degree expressiveness displayed during the stimulus situation. The physiological responses between the two groups were then compared. The results indicated an inverse relationship between facial expressivity and physiological responding. While this study would seem to provide support for the discharge model of emotions, there are problems with the measure of expressivity which render the findings equivocal.

In this study the assessment of facial expressiveness was based upon the number of facial expressions that occured over a given time period. Changes from a neutral display to a nonneutral display and back to a neutral display were considered to consititute one facial expression. Such a procedure is quantitative and only provides a measure of the number of facial expressions displayed over time and does not reflect any assessment of the degree of expressivity per se. It is not necessarily true that individuals who maintain one facial expression over a designated time are less expressive than those who alter their expressions frequently. An additional weakness with the measure used is that "... slight movements of the eyebrows ..." (Notarius & Levenson, 1979, p.1206) and other such gestural behaviors were not counted as facial expressions. The exclusion of such slight movements suggests that the rating of expressiveness ignored the subtlties of facial displays that are considered to be important aspects of expressiveness (Hager & Ekman,1981; Ekman & Oster,1979; Ekman,1985). The validity of the findings reported by Notarius and Levenson (1979) are seriously weakened given these methodological problems.

Notarius, Wemple, Ingraham, Burns and Kollar (1982) questioned the ecological validity of exposing subjects to stimuli such as emotionally evocative slides (Buck et al., 1972; Buck et al., 1974); painful shock (Lanzetta & Kleck, 1970); or to the threat of shock (Notarius & Levenson,1979) in order to elicit natural expressions of emotion. Notarius and colleagues conducted a study eliciting natural and spontaneous facial displays of emotion by exposing subjects to an interpersonal stressor thought to be more characteristic of emotional situations confronting persons in the real world. During the experiment, subjects' heart rate was continously monitored and facial displays were unobtrusively videotaped. Following the stressor situation subjects completed the 'Differential Emotions Scale' (Izard,1977) to assess their affective state. The videotaped facial expressions were coded by naive judges to assess levels of reactivity. Of the material videotaped, three standardized 10-second segments were selected for the judgement phase. The segments were presented in a random order and the judges were asked to rate facial reactivity on a three point scale: "no expression"; "a little reactive"; and "moderately or very reactive". Based upon these judgement ratings, the original experimental subject data was assigned to one of three facial expressivity groups: "non-expressors"; "minimal expressors"; and "high expressors" for comparison of the physiological and self-report data. The results indicated that minimally expressive subjects displayed a significant heart rate increase and evaluated the stressor situation as more threatening than did the expressive or non-expressive subjects. Notarius et al.,(1982) interpreted these findings as consistent with the discharge model of emotions. There were, however, a number of methodological problems with the measure of expressivity.

The reactivity scale used by the judges did not contain clearly discrete items, for example, one possible rating was "moderately or very reactive". However, the term "moderately" is not the same as "very reactive" and thus should not have been grouped together. A four-point scale would have been more accurate and discrete in items, for example: "not reactive"; "minimally reactive"; "moderately reactive"; and "very reactive". Secondly, it cannot be assumed that the standardized segments of recorded facial activity used to determine how expressive an individual was, actually represented the period of greatest expressivity for the individual or was characteristic of their general expressiveness. As a result, subjects may have been inappropriately assigned to a facial expressivity group. This would not be a problem if the comparisons between the groups with respect to physiological reactivity used data which corresponded to the three 10-second segments of rated facial behavior. Unfortunately, this was not the case. The analyses for physiological responses were conducted using twenty-seven 20-second trials. Thus, the possibility of the erroneous assignment of subjects to facial expressivity groups leaves serious doubts as to the validity of the findings.

A more recent study by Winton, Putman & Krauss (1984) used an eliciting stimulus similar to that used by Buck and his colleagues. Subjects viewed and rated a series of 25 emotionally evocative slides while heart rate and skin conductance were continously monitored and facial expressions covertly videotaped. Naive judges subsequently viewed the videotapes and rated the pleasantness and intensity of each subject's facial expressions. Contrary to previous research which used the natural expression paradigm, an inverse relationship between expressivity and arousal was not found. The results indicated physiological differentiation in terms of judged and self-reported pleasantness, however, the relationship was not monotonic. Extreme pleasantness was characterized by cardiac acceleration and decreases in skin conductance; whereas extreme unpleasantness was accompanied by cardiac deceleration and increases in skin conductance.

This pattern of physiological responding was considered by the investigators to be an example of "directional fractionation" in that autonomic patterns in response to stimuli may be in different directions (Lacey & Lacey, 1970,1974). Winton et al.,(1984) suggested that their findings brought into question the utility of a unidimensional view of physiological reactivity that underscores research on the arousal and discharge models of emotion. The arousal model is often taken to imply that physiological responses should increase with expressiveness (Tourangeau & Ellsworth, 1979); while the discharge model is interpreted as predicting a decrease in autonomic responding as overt expressivity intensifies (Tourangeau & Ellsworth, 1979). Interpreted thusly, neither model can accomodate the dissociation between autonomic response systems observed in the study by Winton et al. These findings suggest that a multidimensional conception of physiological responsivity may be a more useful way of characterizing internal responses to emotional stimuli.

Exaggeration/Minimization Paradigm

Within this general paradigm subjects are exposed to emotion-provoking situations and are asked to exaggerate and/or minimize their expressive reactions.

This procedure was first used by Lanzetta, Cartwright-Smith, and Kleck (1976) in order to examine the relationship between the nonverbal display of emotional effect and indices of the emotional state. In this study subjects were asked to conceal or to exaggerate the facial display associated with the anticipation and reception of painful shocks that varied in intensity. Measures of self-report of shock painfulness and skin conductance were obtained. As a procedural check subjects' facial expressions were videotaped and later rated according to the degree of discomfort displayed. Results indicated that posing condition had a highly significant effect upon judges' inferences of shock painfulness: ratings of painfulness were greater when subjects exaggerated their expressions than when minimizing their reactions. This effect was independent of actual shock intensity. Findings also indicated that the minimization of expressive responses decreased the magnitude of skin conductance and subjective reports of painfulness as compared to the exaggeration of pain-related responses. Lanzetta et al.,(1976) concluded that these findings provided support for the arousal model of emotion that predicts a positive relationship between expressive behavior and self-report and physiological responses.

These conclusions were supported in a related study conducted by Kleck, Vaughn, Cartwright-Smith, Vaughn, Colby and Lanzetta (1976). When subjects were informed that they were being observed by another person, they showed less intense facial expressions and, correspondingly, decreased skin conductance responding and subjective ratings of pain even though no explicit instructions to inhibit responses were given.

These studies have been considered to provide the strongest evidence for a positive link between voluntary facial expression and emotional experience (Ekman & Oster,1979). However, before concluding that facial feedback was directly and causally related to the observed changes in arousal, it would be necessary to rule out the possibility that some other strategy used by the subjects might have influenced both their facial expressions and emotional experience (Ekman & Oster, 1979). Buck (1980) criticized the use of electric shock as the affective stimulus employed in these studies, arguing that the subjective state induced by shock (eg., pain) is not clearly an emotional state. Despite these cautions and criticism, these studies remain cited in the literature as providing strong evidence that overt facial expressions can effect the intensity of emotional arousal (Tourangeau & Ellsworth, 1979).

Zuckerman, Klorman, Larrance and Spiegel (1981) conducted a study using the exaggeration/minimization paradigm in which pleasant, unpleasant, and neutral scenes served as the affective stimulus. No effort was made to disguise the nature of the study and subjects were informed that the experiment involved the examination of the physiological correlates of emotion. In the first phase, subjects were randomly assigned to respond to the stimulus films in one of three modes: "suppression" - display a neutral expression regardless of film content; "exaggeration" - exaggerate an expression appropriate to film content; or "spontaneous" - no instruction given regarding expression to be displayed. In the second phase, subjects repeated the "suppression" or "exaggeration" instructions. Measures of self-report, facial expressions, heart rate, respiration rate, blood volume and skin conductance were obtained. Expressivity was later assessed using the "encoding/decoding" paradigm (Lanzetta & Kleck, 1970; Buck et al., 1972; Buck et al., 1974). Facial expressiveness was rated by a group of naive judges in terms of pleasantness and matching of expression to eliciting scene. Analysis revealed that decoding accuracy was greater in the exaggeration mode, intermediate in the spontaneous mode, and lowest in the suppression mode. In addition, exaggeration of facial expressiveness was accompanied by higher levels of autonomic activity and subjective reports of effective experience. These findings were seen to provide support for the arousal model of emotion.

Unfortunately, in this study subjects were aware of the nature of the experiment, and thus the possibility that demand characteristics were responsible for some of the findings was extremely high. The influence of this bias is especially true for the self-report measures of affective experience obtained. Although physiological responses are likely less sensitive to demand characteristics, the possibility of their influence cannot be ignored. In addition, the procedural check for expressivity used an "encoding/decoding" paradigm and, as previously stated, such a procedure does not provide an independent measure of expressivity.

The preceeding review of research which used the natural expression or the exaggeration/ minimization paradigm addressed methodological problems inherent in the individual studies. The following section examines issues that characterize the research as a whole.

Roberts and Weerts (1982) query the use of <u>any</u> standard stimulus administered to a heterogeneous group of subjects, regardless of whatever ecological face validity it may have. These investigators cite research which has found that stimulus meaning is moderated by a complex of subject variables and stimulus attributes (Mischel,1977) such that a "standard stimulus" could seldom be expected to induce similar behavioral, subjective, and physiological responses across subjects (Epstein,1979). The view that a standard stimulus does not evoke uniform subjective responses is evident from the self-report data obtained by Notarius et al. (1982). Of the ten descriptors on the "Differential Emotions Scale", analyses revealed significant differences on six of them: surprise, fear, disgust, anger, shyness, and distress. Clearly subjects did not evaluate the "standard stimulus" in the same manner. Unfortunately, most of the other studies used subjective ratings based on a "pleasant-unpleasant" dimension which does not permit verification of which emotion, if any, was experienced.

As it is unlikely that all subjects experienced the same discrete emotion in response to the "standard stimulus", it is equally unlikely that the facial expressions of the subjects were the same. Assessment of facial behavior involved either judgements of the degree of expressivity displayed or were along the same "pleasant-unpleasant" dimension used in subjective ratings. In studies requesting judgements about the degree of expressiveness displayed the issue that different emotions manifest different facial expressions is particulary important (Ekman,1985). The work of Ekman and colleagues also suggests that facial expressions of some emotions involve more muscles within the face, and hence greater behavioral display, than others. For example fear, surprise, and anger use more muscle groups than happy, disgust, or sadness (Ekman & Friesen,1978). As a result, naive judges rating facial display in terms of degree of expressiveness might inappropriately consider Subject "A" displaying a fear expression as more "expressive" than Subject "B" displaying disgust. Such inappropriate ratings on the part of naive judges would confound the results. The "pleasant-unpleasant" assessment can, at best, show only that different facial expressions are used in presumably pleasant and unpleasant situations. However, there is little information pinpointing the specific facial behaviors that differentiate between these situations (Ekman & Oster,1979). Further, regardless of the assessment method used, the studies did not determine, or standardize, what behavioral configurations observers' were responding to in making their judgements. It is possible that judgements were made on the basis of cues having nothing to do with facial expresssion (eg., posture, gross body movements) or were based on facial signs of cognitive activity (Ekman & Oster,1979; Ekman et al.,1980).

The inability of these studies to discriminate between different emotions also has implications regarding measurement of physiological responding. There is disagreement among emotion theorists whether or not different emotions are characterized by distinctive physiological changes (Ekman, Friesen & Ancoli,1980). Thus, it is felt that any study examining the role of facial behavior in the experience of emotion that includes autonomic indices should address this controversy. Unfortunately, most of the research reviewed does not state a clear position on this issue. The importance of clarification and the need to address this controversy is illustrated in the following fictitious scenario:

Assume that the emotion "anger" is characterized by cardiac acceleration and "happiness" is accompanied by cardiac deceleration. Under investigation are the physiological correlates of expressivity. A naive judge is asked to rate the degree of expressiveness such that subjects will later be designated as "expressors" or "nonexpressors". It is possible that an angry subject and a happy subject, both of whom display a great deal of overt facial behavior, are each designated as "expressors". Analysis of the cardiac response would likely reveal attenuated arousal as the differences in the responses between emotions cancel each other out. This would lead to the erroneous conclusion that expressivity and physiological responding were inversely related.

While the scenario uses an extreme example and assumes autonomic specificity, it nonetheless illustrates the point that misleading conclusions can be drawn if different emotional responses to a seemingly "standard stimulus" are not identified in some manner.

Muscle-by-Muscle Paradigm

In the muscle-by-muscle paradigm the basic technique for manipulating facial expression usually involves giving subjects some plausible excuse and then requesting they contract and relax different facial muscles. The facial movements chosen are considered to be characteristic of the emotion investigated. As specific emotional states are being represented many of the problems discussed with respect to the other paradigms are not at issue here.

The first study of this type was conducted by Laird (1974) The study was done to evaluate the premise that if the quality of emotional experience is derived from expressive behavior, would individuals induced to express an emotion subsequently report feeling that emotion. Laird manipulated his subjects' faces into a "smile" or a "frown" under the guise of taking electromyographic recordings in response to filmclips and found that the subjects' rating of their mood was influenced by their facial expression. Subjects rated their mood more positively and rated cartoons as being more humorous when "smiling" than when "frowning". An interesting note is Laird's inclusion of comments made by one of the pilot subjects (data not used) that fits nicely into the premise that facial expressions play a role in the experience of emotion:

"When my jaw was clenched and my brows down, I tried not to be angry but it just fit the position. I'm not in an angry mood but I found my thoughts wandering to things that made me angry, which is sort of silly I guess. I knew I had no reason to feel that way, but I just lost control" (p.480).

Laird's study has been criticized because self-report measures in a within-subjects design were used, leaving open the possibility that demand characteristics were responsible for the results (Tourangeau & Ellsworth, 1979). However, steps were taken to reduce this possibility by administering a post-experimental questionnaire and any subject who indicated any awareness of the relationship between their expression and feelings were eliminated from the data analysis.

Laird's study was followed by other investigations which indicated that emotional experience could be influenced by facial manipulations. Duncan and Laird (1977) found that subjects rated their moods higher on elation and surgency when their faces were arranged in smiles than when they wore a neutral expression, and rated their moods still lower on those dimensions when they frowned. These effects were obtained without subjects' being able to verbalize the nature of their facial expressions, suggesting that facial proprioceptive cues can have a direct influence on emotional states.

Rhodewalt and Comer (1979) investigated the impact of manipulated expressive behavior on attitude change. Subjects wrote counterattitudinal statements after their facial expressions had been independently manipulated. Findings indicated that subjects who were induced to frown produced greater attitude change than those led to smile. These results suggested that manipulations of facial expressions possibly trigger processes transcending mere mood changes.

This premise was supported in a recent study which assessed the effects of expression on memory (Laird, Wagener, Halal & Szegda,1982). Recall was found to be best when subjects' manipulated facial expressions were consistent with the emotional content of the material recalled. In keeping with Laird's self-attribution variant of the facial feedback premise, this effect was apparent only for subjects who had been designated as using "self-produced cues" in making attributions and not for the "situational cue" subjects.

Response to facial expression manipulations have also added support to the notion that overweight individuals are not responsive to internal cues. Interested in body weight differential in response to proprioceptive cues, McArthur, Solomon and Jaffe (1980) compared the effects of facial manipulation and corresponding self-report between normal and overweight subjects. Findings indicated that only the self-report of normal weight individuals were consistent with the facial manipulation.

These studies seem to provide strong support for the premise that particular expressive behaviors produce, or at least influence, particular emotional states. However, there are several methodological issues which render these findings equivocal. The first issue is one of independent validation of the experimental variable. In these studies the potency of the facial manipulation was based solely upon the subjects' self-report. It is known that self-reports are error-prone: for example, sensitive to demand characteristics and to time that has elapsed before the report is made. Even with the use of elaborate post-experimental questionnaires, the possibility that demand characteristics influenced the results cannot be ruled out. As there likely is no single, infallible way to determine a person's "true" emotional state, it is advisable to use multiple convergent measures to gain a more reliable indication of the emotion experienced (Ekman & Oster,1979). In the studies reviewed, the inclusion of physiological indices would have enhanced the determination of the facial manipulation's potency and permitted assessment of corresponding physiological arousal which is considered to be an important component of the emotive process (Izard,1977;1980). An additional weakness is that none of the studies provided evidence that the facial manipulation was indeed successfully maintained by the subject. Further, it is only possible to assert that a particular facial expression can produce, or influence, a particular emotional state if it has been demonstrated that any unrequested expressions, however slight, did not occur (Hager & Ekman,1981).

Tourangeau and Ellsworth (1979) used the muscle-by-muscle paradigm to examine three hypotheses that they felt were central to a facial feedback model of emotion: were facial expressions sufficient to induce an emotion; were expressions necessary to influence emotional experience; and was the relationship between facial expression and emotional experience (as measured by self-report and physiological indices) positive and monotonic. Using a deception to disguise the nature of the study subjects' facial expressions were manipulated into one of three positions: fear; sadness; or a nonemotional grimace. A control group who received no instruction for facial expression was included. Subjects' held the specified expression for two minutes while watching a film that depicted fear, sadness, or no emotion. Trained raters, blind to the subject's condition, scored videotapes in terms of how sad or afraid the subject appeared. The findings indicated that the films had powerful effects on reported emotions, but the facial expressions had none. Correlations between facial expression and reported emotion were zero, indicating that expression had no effect on subjective experience. Distinctive patterns of physiological arousal were evident between the "sad film" and "fearful film" subjects. The results indicated that facial expressions affected phsyiological responses in a manner consistent with an "effort" or "concentration hypothesis". This hypothesis suggests that physiological responses that occur as a result of facial manipulation are due to the effort or concentration required to produce a facial expression.

The study by Tourangeau and Ellsworth (1979) has received extensive criticism regarding its theoretical assumptions and methodology. Tomkins (1981) and Izard (1981) argued that their respective theories of emotion were incorrectly interpreted and inappropriately combined and labelled the "facial feedback hypothesis". As such the theorists contended that the study examined a contrived, nonexistant hypothesis. In reply, Ellsworth and Tourangeau (1981) stated that rightly or wrongly their interpretation of the facial feedback hypothesis was the "...hypothesis that was in the air, finding its way into introductory psychology textbooks and generally being attributed to Tomkins and Izard" (p.364) and, thus warranted investigation.

Hager and Ekman (1981) and Laird (1981) suggested that the findings of Tourangeau & Ellsworth were anomalistic and attributable to purely methodological weaknesses. A number of the criticisms warrant further discussion. In their study, Tourangeau & Ellsworth had subjects hold the manipulated facial expression for two minutes. Laird suggested that this was too long a time period, cautioning that feedback that was too unnatural would likely have been discounted by the subject or the central nervous system. If this were the case, this could possibily have biased the results against the facial feedback hypothesis. The facial expressions subjects were induced to create have also been criticized as not necessarily being valid analogs of an emotion expression and, as such, did not permit adequate testing of the hypothesis that a particular expression is sufficient, or necessary, to produce a particular emotion (Hager & Ekman,1981; Izard,1981). A valid test of the hypotheses examined by Tourangeau and Ellsworth (1979) would also have required that subjects make only the requested expression. However, Tourangeau & Ellsworth failed to show that expressions, besides the one requested, did not occur (Hager & Ekman,1981). As noted by Izard (1981), other spontaneous expressions could have occured and have mediated the emotional experience influencing subjective and physiological responses. Finally, it has been suggested that demand characteristics possibly lead subjects to ignore the meaning of requested expressions in favor of cues from the film when rating their emotional experience (Hager & Ekman,1981).

McCaul, Holmes and Solomon (1982) reported results consistent with Tourangeau and Ellsworth's (1979) speculation that changes in facial expression influence physiological responses through the effort required in posing. In the first study subjects were asked to portray facial expression associated with being afraid, calm, and normal. Self-report, pulse rate, and skin conductance measures were obtained. Portraying fear produced increases in pulse rate and skin conductance relative to portraying either calm or normal, but posing had no effect on subjective reports of anxiety. In the second study, subjects listened to either a loud or soft noise while changing their expressions to portray fear, happiness, or calmness. Results indicated facial expression influenced pulse rate such that portraying either fear or happiness produced greater arousal than remaining calm. As changes in facial expression once again failed to affect self-report, the overall findings were interpreted to be consistent with an "effort" or "concentration hypothesis".

In both studies the basis for accepting an effort hypothesis as opposed to a facial feedback hypothesis was that self-reports were unaffected by facial expression changes. However, given the method of assessing subjective experience in reponse to facial manipulation used in these studies, the finding is not surprising. In the first study subjects were told that they would be asked to "pretend to experience different emotions by portraying different facial expressions" (p.148). As the authors themselves acknowledge the demand characteristics of such instructions may have conveyed the message to subjects that they should not report any real fear. In consideration of this possible bias it is felt that the results reported do not demonstrate clear support for the "effort hypothesis". For example, an equally viable explanation is that the facial feedback hypothesis did hold true but that concomitant subjective experiences of fear were masked due to the demand characteristics inherent in the study. The second study involved a deception to disguise the true nature of the study and to provide subjects with a plausible excuse for the facial manipulation. While maintaining a particular pose, subjects listened to a loud or soft noise and at the end of the trial rated the intensity of the noise from "barely detectable" to "unbearably loud". This "noise intensity" rating served as the measure of subjective experience. Although noise has been found to produce emotion (Hiroto,1974) whatever affective impact it may have had would not be evident from the self-report measure used. What was measured were subjective ratings of stimulus intensity and these do not provide any indication of effective response to the stimulus. Thus, the measure used to determine the relationship between facial expression and subjective experience was inappropriate. Given the questionable applicability of the subjective measure used, it is felt that the conclusions drawn by the authors regarding the relationship between expressions, physiological and subjective responses are questionable.

Characteristic of research investigating the role of expressive behavior in the experience of emotion (exception, McCaul et al.,1982) is that elicitation or manipulation of facial expressions has not been independent of emotionally evocative stimuli. A recent study by Ekman, Levenson and Friesen (1983) found that emotion-specific activity in the autonomic nervous system could be generated by facial manipulation in the absence of emotion-eliciting stimuli. This study used two different facial expression tasks: subjects were led to construct facial prototypes of emotion using the muscle-by-muscle instruction, and to re-create natural expressions using visual imagery. Six emotions were studied: surprise, disgust, anger, fear, happiness, and sadness. Measures of heart rate, left and right hand temperatures, skin resistance, and muscle tension were obtained for each emotion and each task. Facial behavior was videotaped during the instructed manipulated task to ensure that autonomic data would be included in the analyses only if the instructed set of actions had been successfully made. Self-report measures were obtained for the imagery task only and this data was used as a means to select autonomic data for the analyses. Overall findings indicated that that there were autonomic differences between the six emotions. Consistent across the expression tasks was that heart rate and hand temperatures increased more in anger than in happiness. In the manipulated facial task results indicated that subgroups of emotion could be distinguished on the basis of heart rate and hand temperatures: for heart rate, the changes associated with anger, fear, and sadness differed from those for happiness, surprise, and disgust; hand temperature change associated with anger was significantly different from that for all other emotions. These findings were discussed as supporting a facial feedback premise that expressive behavior can bring forth emotion-specific physiological arousal.

Although this study seemingly demonstrates clear support for the arousal model that expressivity augments internal reactivity, the findings must be accepted with caution. The subjects for the study were actors and scientists (who study the face) and, as Ekman and colleagues point out, it remains to be demonstrated that emotion-specific autonomic activity was not unique to the particular subject pool used. Further, as Ekman et al.,(1983) pointed out the "possibility that knowledge of the emotion label derived from the facial movement instructions or seeing one's own face or the coach's face was directly or indirectly responsible for the effect" (p.1210). In other words, the feedback received during the practice of the facial movements may have had some effect. However, Ekman et al.,(1983) suggested that the experience or knowledge with facial manipulation does not negate the findings, citing the biofeedback literature which suggests that voluntary production of complex patterns of autonomic activity is not possible. While this may be true, the issues of generalizability and the nature of the feedback provided during the facial manipulation requires further investigation. A final point is that because subjects were aware of the nature of the study an important component of the emotive process, subjective experience, could not be assessed. This is an important issue as Ekman and colleagues suggested that physiological differentiation in response to facial manipulation supports the arousal model; whereas McCaul and associates (1982) suggested that autonomic changes in the absence of concomitant subjective experiences supports an effort hypothesis.

Present Study

Empirical support has been found for both the discharge and arousal model of emotion which postulate conflicting influences of expressive behavior in the subjective and physiological experience of emotion. However, as none of the research is unequivocal, the role and relative importance of facial expressions as a component of the emotional process remains unclear.

Using the muscle-by-muscle paradigm, the present study represented an attempt to investigate the subjective and physiological responses to facial expressions thought to be characteristic of specific emotions. The following hypotheses were tested:

(a) is facial expression sufficient to produce an emotional experience, in the absence of emotion-eliciting stimuli, as measured by subjective and physiological indices.

(b) that various types of feedback provided during manipulation of facial expressions will have a differential impact on subjective or physiological indices or both.

In addition, this study attempted to replicate the findings which demonstrated differentiation of autonomic arousal between facial expressions of emotion.

In order to examine the role of facial expressions in the experience of emotion, expressions considered to be characteristic of happiness, a "smile", and that of anger, a "frown" were used. These expressions were selected for the following reasons: (a) they represent opposite, discrete, easily identified, commonly occuring emotions; (b) these expressions utilize very different facial muscles and, as such, provide subjects with a different set of proprioceptive cues; and (c) the emotions characterized by these expressions have been suggested to manifest different autonomic arousal patterns. A "contrived" facial manipulation not indicative of any emotion was included to control for the effects of autonomic arousal that may occur simply as a result of facial expression manipulation.

Three facial feedback conditions were used as there was a possibility of differential subjective or physiological impact between: (a) seeing the experimenter's face performing the facial movement, (b) seeing one's own face in a mirror performing the movement, or (c) receiving no visual feedback during the practice of facial muscle movements.

As it was not desirable for subjects to be aware of the true nature of the study, a deception was used. Subjects were informed that the experiment involved the study of physiological and effective responses to various subliminal stimuli which were embedded into filmclips (Tourangeau & Ellsworth, 1979). In addition to facilitating the deception, filmclips served as a neutral stimlus. Subjects were debriefed regarding the deception at the end of the experimental session (Appendix A).

CHAPTER II

METHOD

Subjects

Thirty-six female undergraduate students were recruited from various psychology courses at Simon Fraser University. Their ages ranged from 19 - 51, with a mean age of 28. Students were randomly assigned to one of three experimental feedback conditions. The participation of students was entirely voluntary and a small renumeration of five dollars was given for participation at the end of the study.

Design

The study employed a 3x6x3x2 (feedback x order of expression x expression x trial) factorial design. The between-subject factors were facial feedback condition (demonstration, mirror, or self) and presentation order of facial expressions. Facial expression manipulation (smile, frown, and contrived) and two manipulation trials were the within-subject factors. The dependent measures were: physiological indices - heart rate, muscle tension, respiration, and body temperature; and self-report of affective state.

Apparatus & Recording Procedures

Physiological Recording

Physiological recordings were made using Beckman Ag-AgCl electrodes filled with Beckman electrode paste and affixed with adhesive collars. All electrode impendences were below 10 kohms.

Data collection and some of the analysis was carried out with the aid of a Data General Nova 3D computer system equipped with an RDOS operating system (H. Gabert, P.Eng., was responsible for system software and hardware). Signals were sampled at a rate of .002 samples/second and stored on a magnetic tape for furthur analysis off-line. Digitized signals could be monitored on a control room CRT display throughout the recording procedure.

Bipolar EMG's were recorded from forearm flexor muscles with the first lead placement 1/3 of the distance from the epicondyle to the styloid process, and the second lead two inches from the first in a distal direction along the same line (Davis, 1959). EMG'S were amplified and bandpass filtered (filter range: 5 - 1000 hz) prior to introduction to the Nova system.

Heart period was recorded from a sternum electrode referenced to the lower back and, following amplification, was fed to a cardiotachometer which provided a continous digital record of R - R intervals.

Respiration was monitored with a strain-guage transducer placed around the subject's upper torso (Gabert, 1983, Note 1).

Hand temperature was monitored by means of a thermistor transducer attached to the first phalange of the middle finger of the subject's nondominant hand. The thermistor was placed in one arm of a bridge at the input of a D.C. amplifier (CEC), the output of which was introduced to the Nova system.

Recording of Facial Expressions

Subject's facial expressions were videotaped using a Sanyo video camera mounted on the wall facing the subject approximately 8 feet away and recorded on a Panasonic AG-6200 cassette recorder. During the "demonstration" facial feedback condition the experimenter's face was videotaped using a Sanyo video camera mounted on another wall approximately 6 feet away and recorded on a Panasonic NV-8200 cassette recorder.

Coding of Facial Expressions

A modified version of the "Facial Action Coding System" (FACS) developed by Ekman and Friesen (1978) was used to score the recorded facial expressions. All videotapes were coded by a certified FACS coder (B.G.), blind to the nature of the study, to ensure that the facial movements for each expression met the requirements outlined by Ekman and Friesen (1978) as being prototypic of that emotion.

The usual FACS method for coding facial expressions requires the coder to examine the video segment and code each muscle movement independently making note of the onset, offset and intensity of each movement. However, as subjects in this study were instructed to perform a particular facial muscle configuration and to relax that configuration, the usual microanalytic coding was not necessary, thus, a modified version of FACS was used.

Segments to be coded were identified by subject position on the videotape and by time units (up to 1/10th of a second) from the time-date generator. For each facial expression, the coder was instructed to code for the presence/absence of specific facial action units (au's). Appendix B outlines which facial action units correspond to the facial manipulations. If all the specified "au's" were present, the segment was accepted as meeting criteria. A segment was rejected if any of the specified "au's" were not present and/or if "au's" not specified were present. Data from a subject were used only if both segments from each of the three facial muscle movements met with criteria. Of the original 36 subjects, only one did not meet criteria for an expression (smile) and was replaced with an alternate who did meet the requirements.

Recording of Self-Reported Affective State

Self-report of mood was recorded on a panel connected to the Nova 3D computer system (H. Gabert,1985, Note 2). The panel contained six "mood" descriptors: (from left to right) surprise, fear, happy, disgusted, angry, and sad. There were four buttons below each descriptor permitting the subject to rate each on a scale of 0 - 3, with 0 = not at all, 1 = slightly, 2 = moderately, and 3 = extremely. Subjects were required to provide a rating for each descriptor on the 0 - 3 scale. They were required to rate each descriptor independently. Subject's affective state was measured by their self-report obtained during the last five seconds of: (1) each baseline measure, and (2) each facial manipulation trial. During each baseline period subjects were requested to provide a rating when a light, positioned beside the television monitor, came on. While maintaining the facial muscle movement subjects were verbally requested to provide a rating.

Stimulus Film

Stimulus film sequences, which subjects were informed contained the subliminal stimuli, were three 50-second clips from a geographical film produced by the Ontario Film Board entitled "The Uneventful Day". This film was selected as it portrayed quiet nature scenes and as such provided a neutral stimulus. The film clips were dubbed onto black & white 3/4 inch reel-to-reel Sanyo AV-3650 videorecorder for playback to subjects. Film sequences were displayed on a 12 inch Sanyo Trinitron television monitor mounted on a metal trolley approximately 6 feet away from the subject.

Facial Manipulation Procedures

All subjects were informed that they would be viewing three short videoclips containing subliminal stimuli and that for each clip they would be instructed to maintain a particular facial muscle movement. Subjects were told that a training period for each facial movement would preceed the videoclip.

The first part of the training required that subjects listen to a verbal description of the facial movement without trying the movement. The second part involved their trying the movement themselves. At this point feedback to subjects was provided consistent with their experimental facial feedback condition. In the third and final phase of training they were to practice holding the facial movement for thirty seconds and, when requested to do so, rate their mood on the self-report panel. This final phase of training also represented the first facial manipulation trial during which physiological and self-report data were obtained.

Facial Feedback Condition - Instructions

Subjects were randomly assigned to one of the following three facial feedback conditions.

Demonstration Condition

Subjects were told that following the verbal description and before trying the facial movement themselves, the experimenter would demonstrate the movement. Following the demonstration, subjects were asked to try the movement. Verbal feedback and/or demonstrations of the required movement were provided.

Mirror Condition

Subjects were provided with a hand mirror following the verbal description of the facial expression manipulation. Subjects were requested to look in the mirror while trying the facial movement. Verbal feedback was provided to subjects while they were looking at themselves in the mirror.

Self Condition

In this condition subjects were requested to try the facial movement themselves following the verbal description without any visual aid. The experimenter provided only verbal feedback.

Facial Expression Manipulation - Instructions

Instructions given for facial expression manipulation were identical for subjects in all conditions. The facial expression selected to represent happy, a smile; and angry, a frown, were those that have been theoretically defined by Ekman and Friesen

(1978) and have been cross-culturally validated. The "contrived" expression consists of muscle movements not indicative of any emotional expression (Tourangeau & Ellsworth, 1979).

The following instructions were given for each facial expression:

Smile Expression:

"I'd like you to relax your jaw and open your mouth slightly. Now pull your lips back and up towards your ears, as you do so you should also feel your cheeks raise up".

Frown Expression:

"I'd like you to lower your brows and pull them together towards the bridge of your nose. Tighten the muscles around your eyes by squinting slightly. Now tense your jaw muscles by clenching your teeth and also purse your lips together".

Contrived Expression:

"I'd like you to close one eye and one eye only. Now keeping your mouth closed, lightly puff out your cheeks".

Testing Procedure

Each subject was greeted and given a brief written outline of the study entitled "Subject Information - Physiological and Mood Correlates in Response to Subliminal Stimuli" (Appendix C). After reading the outline subjects were asked if they were willing to participate and, if so, to sign the outline and the

Departmental Subject Participation Consent Form.

Once the physiological recording devices were affixed, the experimental procedure was as follows. The experimenter left the room and subjects were given a five minute rest period. Approximately 4 1/2 minutes later, the experimenter re-entered the room to inform subjects that in 30 seconds the light would come on and they were to provide a "mood" rating. It was during the last 30 seconds of the rest period that the first baseline physiological data was obtained and during the last 5 seconds a measure of self-reported affective state was obtained.

The experimenter then re-entered the room and the training for the first facial expression manipulation began, consistent with the subject's specific facial feedback condition. In the final phase of training, representing Trial 1, subjects were requested to maintain the facial movement while looking at the blank television monitor and physiological data was recorded. During the last 5 seconds of maintaining the facial movement subjects were verbally requested to provide a "mood" rating while holding the facial movement.

Following this trial subjects were again requested to hold the specific facial expression while viewing the first 50-second videoclip and to provide a rating upon request. Physiological data was obtained while subjects were watching the videoclip and affective data was obtained during the last 5 seconds. This second manipulation represented Trial 2.

The experimental procedure as outlined was repeated for the remaining two facial expression manipulations. Timeline of procedure is provided in Appendix D. Upon completion of the experimental procedure subjects were asked if they had any comment or question about the study.

Preparation for Analysis

Self-Report Data

Original self-report data were transformed into "change scores" prior to analyses. Change scores consisted of baseline rating of each emotion descriptor subtracted from rating obtained during each facial trial. Relative to baseline, this transformation permitted assessment of whether subjective rating of specific descriptors increased or decreased during posing of facial expressions.

Physiological Data

Of the five physiological measures that were to be included in the analyses, only heart rate, muscle tension (from left and right forearm flexor muscles), and respiration were used. Due to technical problems with the CEC amplifier, the measure of hand temperature was not reliable and, thus, was not included.

Of the physiological data recorded, a 10-second period 5-seconds prior to subjects providing a self-report of mood was prepared for further analysis. This time period was selected for the following reasons: (a) provided an index of autonomic activity which would correspond relatively close in time to the subjective rating of emotion experienced; (b) would not reflect any physiological changes that were the result of subjects' physically and cognitively preparing to self-report; and (c) would not include spurious physiological changes in response to initial facial posing. While the time sample selected was considered to represent the 'cleanest' measure of emotion-induced autonomic reactivity, a limitation was that the length of time facial expressions were held between the two trials was not equal. In Trial 1 the facial expression was held 10-seconds prior to sampling time and in Trial 2 expression was held 25-seconds before sampling.

Using the Nova computer system 10-second 'snapshots' were made of the original physiological data stored on magnetic tape. There were nine snapshots generated per subject representing 10-seconds of data for each facial expression and three periods of recording: baseline, facial manipulation trial 1 and 2. The data for heart rate and muscle tension was then submitted to an area/amplitude analysis (H. Gabert,1983,Note 3).

Heart Rate

The area/amplitude analysis provided a measure of the average amplitude of heart rate in A-D units (analog-digital units). Linear calibration obtained after data collection made it possible to convert the average amplitude in A-D units to a measure of average heart rate in beats per minute (Appendix E provides details of formula used).

Muscle Tension

Muscle tension (EMG) data were a bipolar signal and, as such, were rectified according to baseline. The area/amplitude analysis provided a measure of the average amplitude of the rectified data in A-D units. Although data were left in A-D units for analyses, it was still possible to determine if any increases or decreases in muscle tension occured.

Respiration

As there is individual variablity in the number of respiration cycles that could occur in a given 10-second period only information from the last respiration cycle was used. From the snapshot, the period in seconds, of the last inspiration to expiration cycle was calculated. (Appendix E provides the formula used).

Following these procedures, the physiological data obtained for each measure were then transformed into change scores prior to further analyses. Change scores consisted of the log of each facial manipulation trial after division by baseline. Logarithmic transformation were performed to control for individual variance in physiological responding. As with the self-report data, these transformations permitted assessment of whether autonomic activity increased or decreased during posing of facial expressions relative to baseline measure.

CHAPTER III

RESULTS

Self-Report Data

The self-report change scores were analyzed in a 3x6x3x2x6 (Feedback x Order x Expression x Trial x Descriptor) repeated measures analysis of variance (complete analysis is presented in Appendix F). Analysis indicated a significant main effect for descriptor, $\underline{F}(5,90) = 7.89$, $\underline{p} < .001$ and an expression by descriptor interaction, $\underline{F}(10,180) = 4.81$, $\underline{p} < .001$.

The nature of the interaction was further explored using a 3x6x3x2 repeated measures analysis of variance treating descriptor as a variable with six levels (complete analyses are presented in Appendix G). To control for experiment-wise error, a Bonferroni-t was used to adjust the alpha level necessary for significance (.05/6=.008). Using this correction only an expression main effect for the descriptor "angry" was significant, $\underline{F}(2,36) = 9.05$, $\underline{p} < .001$. For the descriptor "happy", a main effect for expression just missed reaching significance, $\underline{F}(2,36) = 5.29$, $\underline{p} < .009$.

The means and standard deviations of change scores for each descriptor are provided in Appendix H. Inspection of marginal means averaging over feedback condition, order of expression presentation, and trial suggests that self-reported emotion was consistent with the specific facial expression posed. This observation was confirmed by pairwise comparisons. The results for comparisons of descriptor means between expressions are presented in Table 1 and Figure 1. Using the Studentized Range Statistic comparisons were performed averaging across all other factors (which do not exert significant effects). In the frown expression ratings for the "angry" descriptor were significantly higher than those obtained during the smile or contrived expression. There was no difference in ratings of "angry" between the smile and contrived poses. Ratings for the "happy" descriptor were higher with the smile expression as compared to the other two. The frown and contrived expressions did not differ from each other on ratings of "happy".

Although significant differences in change score ratings of "happy" and "angry" were evident between expressions, it was also necessary to examine if these target descriptors of an emotion differed from others within the specific expression. The results of multiple comparisons performed between descriptors within expression are presented in Table 2. In the smile expression the mean change score for "happy" did not differ from any other descriptor. Change score ratings for "angry" in the frown expression were significantly different from all other descriptors. In the contrived expression the descriptor "disgusted" obtained the highest mean change score rating and was used as the target descriptor for comparisons. Results indicated that only ratings for "happy" differed significantly.

Table 1

Comparisons of "Angry" & "Happy" Descriptor Change Score Means Between Expressions Averaged over Feedback, Order, and Trial

Descriptor	Expression	Mean	Comparison		
Angry	Smile (S)=	.014	(F)-(S)=	.431	*
	Contr.(C)=	.153	(F)-(C)=	.264	**
	Frown (F)=	.417			
			(C)-(S)=	.167	
Happy	Frown (F)=	-.375	(S)-(F)=	.528	*
	Contr.(C)=	-.278	(S)-(C)=	.431	**
	Smile (S)=	.153			
			(C)-(F)=	-.097	

* exceeds critical difference of .253
** exceeds critical difference of .212

Figure 1

Comparisons of "Angry" and "Happy" Descriptor Change Score Means Between Expressions, Averaged over Feedback, Order, and Trial

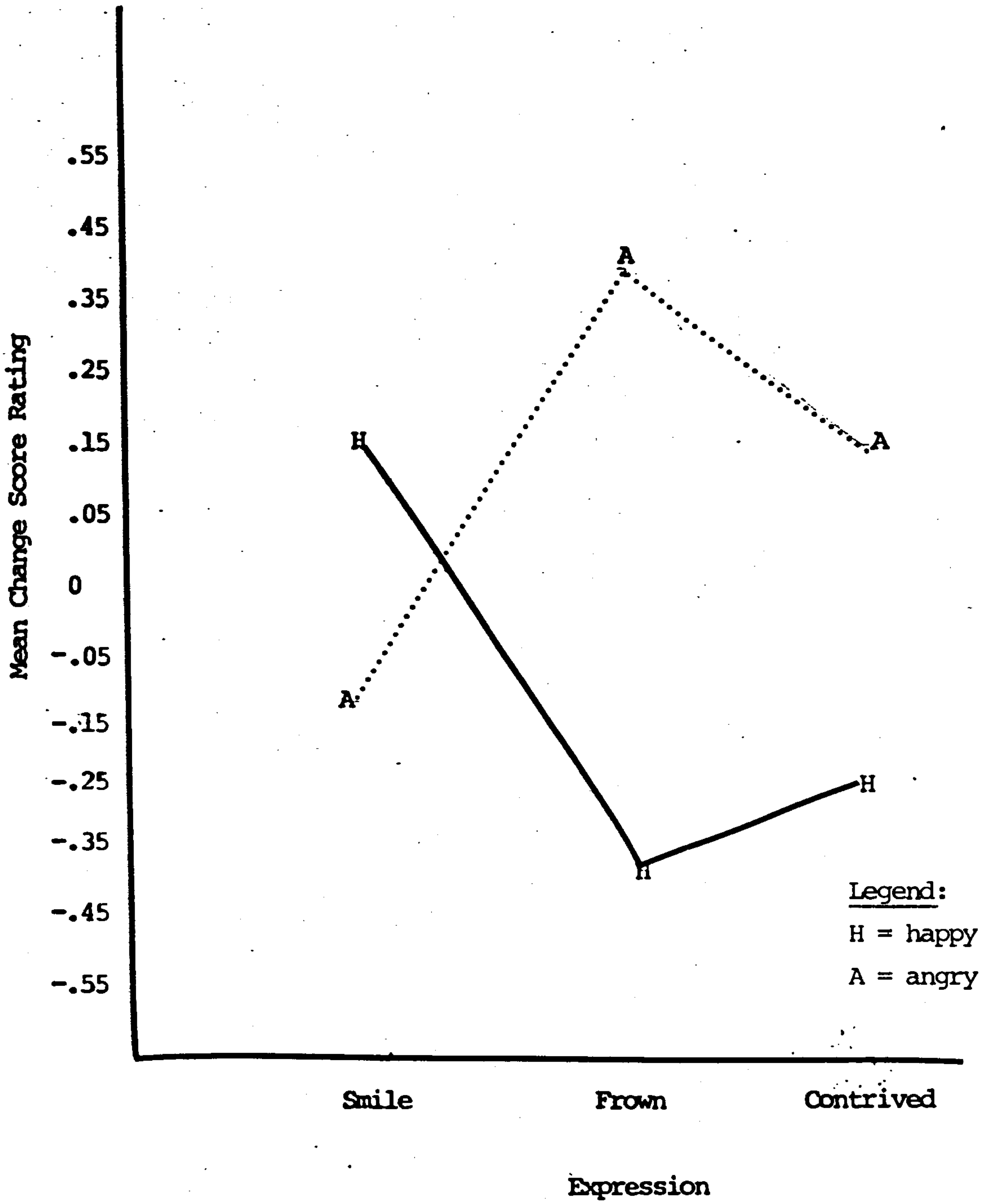


Table 2

Comparisons of Descriptor Change Scores Means Within Expression Averaged over Feedback, Order, and Trial

Expression	Descriptor	Mean	Comparison		
Smile	Sad (S)	= -.138	(H)-(S)	= .291	
	Angry (A)	= -.014	(H)-(A)	= .167	
	Fear (F)	= .000	(H)-(F)	= .153	
	Disgusted (D)	= .083	(H)-(D)	= .070	
	Surprise (Sr)	= .111	(H)-(Sr)	= .042	
(Target)	Happy (H)	= .153			
Frown	Happy (H)	= -.375	(A)-(H)	= .792	*
	Fear (F)	= -.069	(A)-(F)	= .486	**
	Sad (S)	= -.056	(A)-(S)	= .473	***
	Surprise (Sr)	= .069	(A)-(Sr)	= .348	#
	Disgusted (D)	= .194	(A)-(D)	= .223	##
(Target)	Angry (A)	= .417			
Contrived	Happy (H)	= -.278	(C)-(H)	= .514	*
	Sad (S)	= .014	(C)-(S)	= .222	
	Fear (F)	= .028	(C)-(F)	= .208	
	Surprise (Sr)	= .139	(C)-(Sr)	= .097	
	Angry (A)	= .153	(C)-(A)	= .083	
(Target)	Disgusted (D)	= .236			

* exceeds critical difference of .322
** exceeds critical difference of .308
*** exceeds critical difference of .289
\# exceeds critical difference of .264
\## exceeds critical difference of .221

Physiological Data

The means and standard deviations of change scores for the autonomic indices are reported in Appendix I. The logarithmic change scores computed for each measure were analyzed in a 3x6x3x2 (Feedback x Order x Expression x Trial) repeated measures analysis of variance (complete analyses are presented in Appendix J). As it was necessary to test each measure individually a Bonferroni-t correction (.05/4=.012) was used to determine significance. Using this revised alpha level no significant results were evident, although just missing significance were: left-arm muscle tension, $F(2,16) = 5.54$, $p < .015$, and a trial main effect for heart rate, $F(1,16) = 6.65$, $p < .020$. Inspection of the means reported in Appendix I suggests that right-arm muscle tension for the mirror feedback condition was somewhat higher and that heart rate decreased somewhat during the second manipulation trial. However, as these factors did not reach significance in the analysis of variance subsequent comparisons were not done to further explore the differences observed between the various means.

CHAPTER IV

DISCUSSION

The present study provided partial support for only one of the hypotheses examined. Findings suggested that manipulations of facial expressions, in the absence of affective stimuli, were sufficient to produce complementary changes in subjective responses but not concomitant changes in physiological arousal. Further, the different types of feedback provided during training of the facial expressions did not significantly influence any of the dependent measures.

The finding that subjects reported feeling more "angry" when frowning and more "happy" when smiling was consistent with previous research which compared responses of these two expressions (Laird,1974; Duncan & Laird,1977; McArthur et al.,1980). However, prior to concluding that a specific subjective emotional experience was generated by a specific facial manipulation, other possible explanations for the results must be ruled out.

Izard (1981) described unpublished studies which examined experimenter-manipulated voluntary muscle contractions in the absence of emotion-eliciting stimuli that found self-reported anger to be significant regardless of which facial muscles were manipulated. In the present study the possibility that high ratings of "angry" when subjects were induced to frown was a general response to experimenter-manipulation is inconsistent with the subjective ratings obtained for the other expressions. In all comparisons performed neither the smile or the contrived pose evidenced ratings of "angry" to be significantly higher than those reported for the frown expression. This suggests that high ratings of "angry" when frowning were in response to proprioceptive facial cues that patterned the emotion of anger.

Although comparisons of descriptor means between expressions did indicate that subjects reported feeling happier when smiling than if maintaining a frown or contrived pose, the comparisons of descriptors within the smile facial manipulation revealed that mean change score ratings of "happy" did not differ from any other descriptor. Two explanations, each having its own implications regarding the role of facial gestures in the emotive experience, may account for this finding.

The nonsignificant differences obtained between descriptors for the smile expression may have been the result of a ceiling-effect due to the restricted range provided for self-report ratings. Unlike previous research, baseline ratings of mood were obtained and the effect of facial manipulation was examined using change scores. While this procedure provided a stringent test for the influence of facial behavior on subjective experience, change scores are sensitive to a restricted range. To evaluate an emotion like happy, it may be necessary to use a rating scale that permitted subjects to make finer discriminations of their emotional state for a change in response to a smile manipulation to be evident.

Alternatively, the results may accurately reflect the fact that the influence of facial manipulation upon subjective experience was more potent for the frown expression than for the smile pose. It is possible that different facial muscle configurations do not provide individuals with equally potent proprioceptive facial cues. As most research on the role of expressive behavior is based upon comparisons between smile and frown expressions, this possibility remains to be examined. It is also possible that individuals evaluate cues from the various muscle configurations differently, responding to some and not to others. This study, as well as previous research reviewed, examined differences between group means and, as such, little is known about individual variability in response to facial behavior. In other words when comparing two expressions, we do not know if the complementary self-report findings for each expression were generated by the same subjects each time. Laird (1974,1981,1982) noted that not all subjects responded to facial cues, and suggested that there were responders (used self-produced cues) and nonresponders (who used situational cues). Although this provides some insight regarding individual differences, research has still to determine if individuals who do respond do so selectively or generally.

Studies using only self-report measures which demonstrated a positive relationship between facial display and the experience of emotion have been criticized for results biased towards accepting an arousal or facial feedback model due to demand characteristics inherent in the research (Buck,1980; Tourangeau & Ellsworth,1979; Zuckerman et al., 1981). In adopting a given expression, a subject might have consciously or unconsciously concluded that a corresponding emotion was desired by the experimenter and responded accordingly. However, if physiological measures are included this explanation cannot account for changes in autonomic activity. Although the present study recorded heart rate, respiration, and muscle tension to obtain a convergent measure of the emotional response to facial manipulation, concomitant changes in physiological reactivity were not obtained. This finding raises two related issues: (a) were the self-reports consistent with facial expression the result of demand characteristics, and (b) is physiological responding necessary before it is possible to conclude that an emotion was genuinely experienced?

First it should be pointed out that demand characteristics are an issue with any research study, especially one using undergraduate psychology students as the subject population. In the present study the possibility that experimental demands influenced the results cannot be completely ruled out given the nonsignificant changes in physiological activity. However, there are several factors which are considered to reduce the possibility that demand characteristics were the primary source of positive self-report findings.

A deception was used to disguise the true nature of the study and great care was taken to enhance the plausibility that the investigation concerned the perception of subliminal stimuli. For example, minute "glitches" and shifting scenes in each filmclip made it appear as if some editing had taken place for the insertion of the subliminal stimuli. However, a post-experimental questionnaire was not used as a procedural check to verify the effectiveness of the deception.

Perhaps a stronger indication that demand characteristics did not bias the self-report findings were the nonsignificant differences observed between feedback conditions. The inclusion of variable feedback during training of facial expressions was not to control for experimental demands, but nonetheless in retrospect, this would appear to have been accomplished. For example, if self-reports reflected responses to demands of the study, it would follow that ratings for subjects in the demonstration condition should be the highest, and those for subjects receiving neither demonstration or mirror feedback, the lowest. However, the results indicated that feedback did not exert a significant influence on any of the dependent measures. These factors would seem to reduce the possibility that demand characteristics influenced the findings of the present study.

The second question to be examined is whether it is possible to conclude that a genuine emotion was experienced by subjects given the lack of change observed in physiological responding. Both Tomkins (1980) and Izard (1977,1980) suggest that visceral responses, while important, play a secondary role in emotion. Essentially, autonomic arousal is viewed as an auxillary process that may serve to sustain an emotion after its neural activation by sensory feedback from the face. It is this view that differentiates the facial feedback premise from the position postulated by James which focused on general arousal as the basis for emotions. Thus, there is some theoretical support which suggests that it is possible for emotion to be experienced without observable concomitant physiological changes. As other explanations for the present findings have either been ruled out or weakened, it seems reasonable to suggest that facial behavior can influence the subjective experience of emotion.

The results of the present study indicate neither a significant increase or decrease in any measure of physiological activity in response to facial manipulations. These findings appear to be contrary to the empirical support demonstrated for the arousal model which predicts a positive relationship between physiological reactivity and facial expressions (Lanzetta & Kleck,1977; Kleck et al.,1977; McArthur et al.,1980; Ekman et al.,1983). Likewise, the present results do not provide support for the discharge model which postulates an inverse relationship (Buck et al.,1972; Buck et al.,1974; Notarius et al.,1979; Notarius et al., 1982). However the present study, unlike previous research, did not examine the influence of expressive behavior in conjunction with an emotion-eliciting stimulus. Kleck and Lanzetta (1977, cited in Buck,1980) have suggested that posed facial expression in the absence of any affective stimuli fails to produce physiological arousal. This suggests that while facial behavior alone may be sufficient to influence subjective experience, physiological responding requires a more potent induction.

The speculation that physiological responding requires a more powerful induction than provided by facial cues alone seems inconsistent with studies that have been considered to demonstrate autonomic responding in the absence of a stimulus (McCaul et al.,1982; Ekman et al.,1983). While an explicit emotion-eliciting stimulus was not used, a reappraisal of the methods and/or subject population used in these studies suggests the possibility of "internal" stimuli. Roberts and Weerts (1982) and Ekman et al.,(1983) have demonstrated that visual imagery of emotions generated by subjects without an eliciting stimulus was sufficient to produce autonomic responses and differentiation between emotions imaged.

The use of imagery is clearly implied in the study by McCaul et al.,(1982) where subjects were asked to "pretend" to experience different emotions. In the study by Ekman and colleagues, actors (likely accustomed to portraying different emotions quickly) and scientists (who study the face) served as the subject population. Although the subject population may have been unique to begin with, there is also the strong probability that subjects had knowledge of the emotion that the facial manipulation represented. The investigators felt that knowledge of the emotion alone could not account for the specificity in physiological responding observed between expressions posed.

What has been overlooked is that this knowledge was not necessarily passive, but may have involved an active cognitive process, such as imagery, at an unconscious level which served as an "internal" stimulus.

This reappraisal of the findings by McCaul et al.,(1982) and Ekman et al.,(1983) are more in line with the speculation that physiological responding requires a more potent induction than provided by facial expression alone. It is felt that the present study, using a deception which de-emphasized the focus on emotions, likely did not invoke the use of imagery by subjects and, thus, concomitant changes in autonomic activity in response to facial cues was not observed.

Summary

The findings of the present study were in accord with the arousal or facial feedback prediction that facial expressions influence the subjective experience of emotion. However, the observation that this effect was most prominent for the frown expression raises the possibility that individuals may evaluate facial cues from emotion-prototypic muscle configurations differently, responding to some but not to others. This suggests that the influence of facial cues upon subjective experience is not necessarily an invariant one. Further research to clarify the role of individual response patterns to facial expressions is warranted.

Manipulations of facial expressions, in the absence of affective stimuli, did not produce increases or decreases in any measure of physiological responding. These findings do not help to clarify whether the arousal or discharge model provides a more accurate prediction of the relationship between expressive behavior and autonomic activity. However, the findings do indicate that while facial behavior is sufficient to produce complementary changes in subjective experience, physiological responding requires a more potent induction than provided by expressive behavior alone.

Appendix A

Subject Debriefing

At the onset of the experiment you were informed that the focus of this study was to examine the physiological and emotional correlates in response to subliminal perception. You were told that due to the nature of the subliminal stimuli and the specific physiological measures we were interested in that it was necessary to have you relax and contract certain facial muscles. This was not the true purpose of the study. What we were interested in were your physiological and emotional responses to the manipulated facial expressions. The videotape you viewed did not contain any subliminal stimuli. This deception was used to divert your attention from the true nature of the study. Had you been expressly aware that we were interested in your responses to the facial expressions alone this would likely have biased our findings. To avoid this possible bias the explanation of subliminal perception was given.

I would appreciate it if you would not discuss your participation in this study with your fellow students as some of them may also have agreed to participate in this study. If, at the end of the study, you would be interested in what our findings were I would be more than willing to discuss the results with you. Again, thank you for volunteering to participate in this study.

Appendix B

Facial Action Units Corresponding to Facial Expression Manipulations

Smile Expression

Relax jaw & open mouth slightly: (au 25 or 26)

Pull lips back and up towards ears: (au 12)

Raise cheeks upwards: (au 6)

Prototypic Configuration: 6 + 12 + 25/26

Frown Expression

Lower brows & pull towards bridge of nose: (au 4)

Tighten muscles around eyes: (au 7)

Tense jaw muscles by clenching teeth

and pursing lips together: (au 23 or 24)

Prototypic Configuration: 4 + 7 + 23/24

Contrived Expression

Close one eye: (au 43 with left or right eye)

Puff out cheeks: (action descriptor 34)

Allowed presence of au 6 and/or au 4

Configuration: L/R 43 + 34

Appendix C

Subject Information

Physiological and Mood Correlates in Response to Subliminal Stimuli

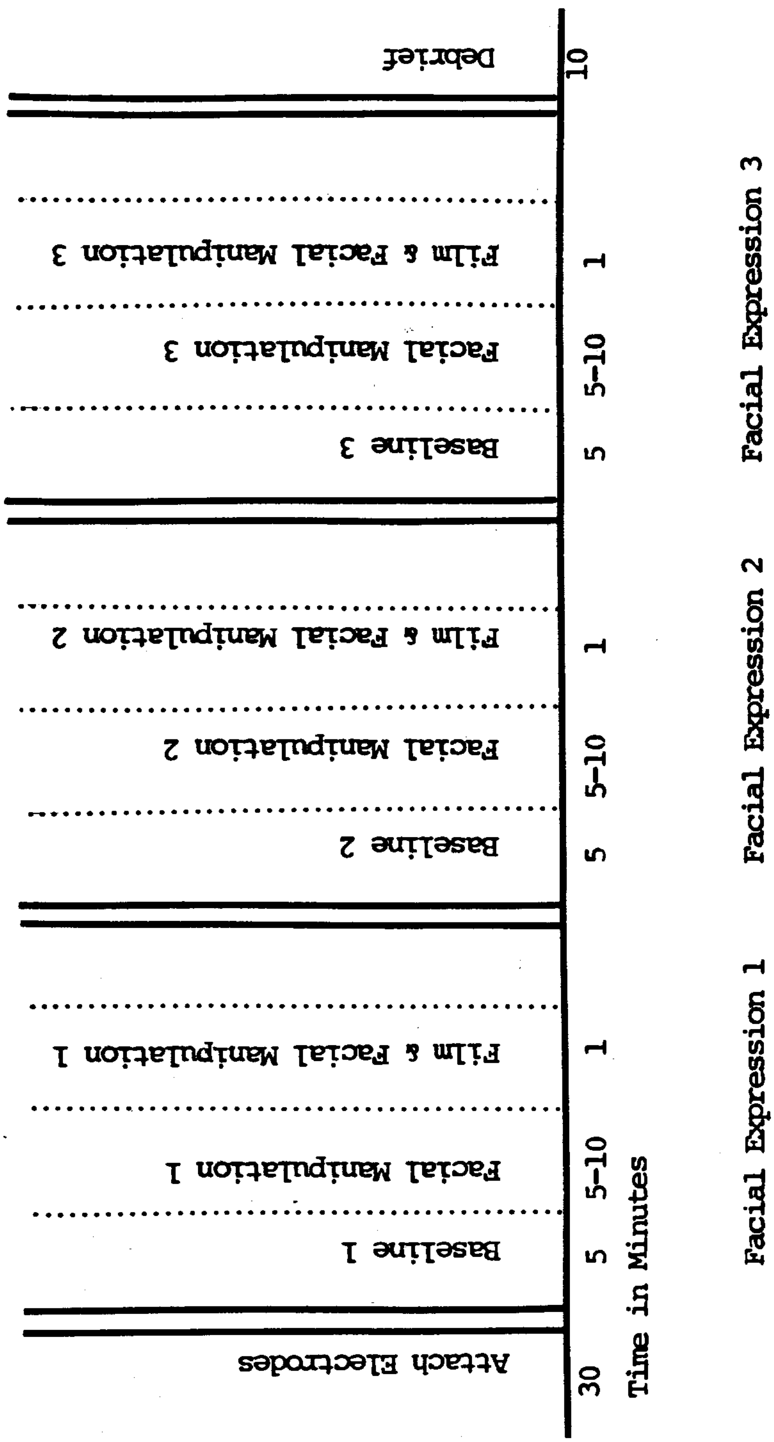
In this experiment I will be recording your heart rate, hand temperature, muscle tension, and respiration in response to subliminal stimuli. This is done by attaching physiological recording devices to your upper torso and back, middle finger, forearm muscles, and around your torso. These devices are sensitive to any movements in the specified areas and will transfer electrical impulse to the recording equipment in the next room.

The subliminal stimuli are single frames that have been edited onto a videotape film. There are three short video films to be seen. Due to the nature of the subliminal stimuli and the specific physiological measures I am interested in, you will be asked to relax and contract certain facial muscles. A videotape recording will be made to ensure that you have maintained the specific facial movement requested.

Lastly, I am also interested in any mood changes that occur in response to the subliminal stimuli and so you will be asked to push buttons on a "Mood Scale" before and during each video segment. The entire experimental procedure should take about 90 minutes.

Appendix D

Procedure Timeline



Conversion Formulas

1). Procedure to convert from A-D units to Beats/Minute:

A) Determine if calibration is linear:

calibration values 100 msec/beat = .09080 AD units

1300 msec/beat = 1.13193 AD units

$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{AD units}}{\text{msec/beat}} = \frac{1.13193 - .09080}{1300 - 100} = \frac{1.0413}{1200} = .8676\text{x}10^{-3}$$

Linear equation: $y = ax + b \qquad ax = y - b \qquad x = \frac{y - b}{a}$

where: a = slope

x = msec/beat

y = AD units

Solve for b at 1300; 100:

$$1300 = \frac{1.13193 - b}{.8678\text{x}10^{-3}} \qquad 100 = \frac{.09080 - b}{.8676\text{x}10^{-3}}$$

$$(1300)(.8676\text{x}10^{-3}) = 1.13193 - b \qquad (100)(.8676\text{x}10^{-3}) = .09080 - b$$

$$b = 1.13193 - 1.12788 \qquad b = .09080 - .08678$$

$$= .0045 \qquad = .00404$$

as values obtained for b are equal indicate calibration is linear

B) Equation to convert AD units to Beats/Minute:

$$x = \frac{y - b}{a} \qquad x = \frac{y + .00405}{.8676 \times 10^{-3}}$$

Therefore, if average amplitude = .78219:

$$x(\text{msec/beat}) = \frac{.78219 + .00405}{.8676 \times 10^{-3}}$$

$$= .906.22$$

Convert msec/beat to beats/minute:

$$\text{beats/min} = \frac{60000 \text{ msec/beat}}{906.22 \text{ msec/beat}} \equiv 66 \text{ beats/minute}$$

2). Procedure to calculate length of inspiration/expiration cycle

A) Each 10-second snapshot of respiration data contained 2500 data points, with a dwell time of .004 seconds (represents distance in time between data points)

B) Determined was the distance between a data point representing the beginning of a cycle (inspiration) and a data point representing the end of a cycle (expiration)

C) This difference represented the length of a cycle in data points, multiply difference by dwell time = length of cycle in seconds

eg). point 1 = 1415 point 2 = 2000 difference = 585

(585) (.004) = 2.34 seconds

Appendix F

Repeated Measures Analysis of Variance: Self-Report Data with Descriptor as a Single Variable

Analysis of Variance

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	1.77778	1	1.77778	5.26	0.0341		
	feedb	0.31019	2	0.15509	0.46	0.6392		
	order	2.84259	5	0.56852	1.68	0.1899		
	fo	4.04167	10	0.40417	1.20	0.3553		
1	ERROR	6.08333	18	0.33796				
	express	0.08796	2	0.04398	0.11	0.8996	0.8936	0.8996
	ef	0.74074	4	0.18519	0.45	0.7739	0.7677	0.7739
	eo	4.73611	10	0.47361	1.14	0.3593	0.3604	0.3593
	efo	4.79630	20	0.23981	0.58	0.9022	0.8981	0.9022
2	ERROR	14.91667	36	0.41435				
	trial	0.07716	1	0.07716	0.72	0.4058		
	tf	0.12191	2	0.06096	0.67	0.5741		
	to	0.09877	5	0.01975	0.19	0.9644		
	tfo	0.84105	10	0.08410	0.79	0.6393		
3	ERROR	1.91667	18	0.10648				
	et	0.26080	2	0.13040	1.52	0.2319	0.2330	0.2319
	etf	0.42901	4	0.10725	1.25	0.3066	0.3077	0.3066
	eto	0.95216	10	0.09522	1.11	0.3803	0.3815	0.3803
	etfo	2.88580	20	0.14429	1.68	0.0847	0.0907	0.0847
4	ERROR	3.08333	36	0.08565				
	descrip	21.24074	5	4.24815	7.98	0.0000 *	0.0004	0.0000
	df	2.36574	10	0.23657	0.44	0.9204	0.8238	0.9204
	do	14.75000	25	0.59000	1.11	0.3508	0.3758	0.3508
	dfo	37.33796	50	0.74676	1.40	0.0816	0.1530	0.0816
5	ERROR	47.91667	90	0.53241				
	ed	20.33796	10	2.03380	4.81	0.001 *	0.0011	0.0000
	edf	6.47222	20	0.32361	0.77	0.7520	0.6470	0.7520
	edo	18.72685	50	0.37454	0.89	0.6861	0.6129	0.6861
	edfo	37.43519	100	0.37435	0.89	0.7474	0.6663	0.7474
6	ERROR	76.08333	180	0.42269				
	td	0.77469	5	0.15494	1.48	0.2039	0.2277	0.2039
	tdf	0.66512	10	0.06651	0.64	0.7796	0.7102	0.7796
	tdo	2.88272	25	0.11531	1.10	0.3573	0.3750	0.3573
	tdfo	7.87191	50	0.15744	1.50	0.0462	0.0883	0.0462
7	ERROR	9.41667	90	0.10463				
	etd	0.33179	10	0.03318	0.25	0.9898	0.9200	0.9898
	etdf	2.50617	20	0.12531	0.96	0.5172	0.4808	0.5172
	etdo	5.45525	50	0.10910	0.83	0.7736	0.6768	0.7736
	etdfo	8.84568	100	0.08846	0.68	0.9846	0.9210	0.9846
8	ERROR	23.58333	180	0.13102				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9664	1.0000
4	0.9441	1.0000
5	0.5262	1.0000
6	0.4455	1.0000
7	0.6371	1.0000
8	0.4381	1.0000

* significant at alpha .008

Appendix G

Repeated Measures Analysis of Variance:
Self-Report Data with Descriptor as a Variable with 6 Levels

Analysis of Variance for Descriptor: HAPPY

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	6.00000	1	6.00000	5.18	0.0352		
	feedb	0.77778	2	0.38889	0.34	0.7190		
	order	5.11111	5	1.02222	0.88	0.5123		
	fo	11.94444	10	1.19444	1.03	0.4565		
1	ERROR	20.83333	18	1.15741				
	express	11.36111	2	5.68056	5.29	0.0097	0.0108	0.0097 *
	ef	2.61111	4	0.65278	0.61	0.6596	0.6528	0.6596
	eo	7.52778	10	0.75278	0.70	0.7172	0.7114	0.7172
	efo	16.16667	20	0.80833	0.75	0.7472	0.7419	0.7472
2	ERROR	38.66667	36	1.07407				
	trial	0.01852	1	0.01852	0.12	0.7356		
	tf	0.03704	2	0.01852	0.12	0.8897		
	to	0.31481	5	0.06296	0.40	0.8424		
	tfo	2.12963	10	0.21296	1.35	0.2768		
3	ERROR	2.83333	18	0.15741				
	et	0.06481	2	0.03241	0.10	0.9051	0.8948	0.9051
	etf	1.12963	4	0.28241	0.87	0.4905	0.4859	0.4905
	eto	2.60185	10	0.26019	0.80	0.6270	0.6211	0.6270
	etfo	4.20370	20	0.21019	0.65	0.8472	0.8393	0.8472
4	ERROR	11.66667	36	0.32407				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9569	1.0000
4	0.9421	1.0000

* Misses significance at adjusted alpha .008

Analysis of Variance for Descriptor: DISGUSTED

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	6.33796	1	6.33796	21.73	0.0002		
	feedb	0.03704	2	0.01852	0.06	0.9387		
	order	4.02315	5	0.80463	2.76	0.0508		
	fo	9.51852	10	0.95185	3.26	0.0141		
1	ERROR	5.25000	18	0.29167				
	express	0.89815	2	0.44907	1.80	0.1805	0.1816	0.1805
	ef	1.68519	4	0.42130	1.69	0.1748	0.1767	0.1748
	eo	0.99074	10	0.09907	0.40	0.9397	0.9367	0.9397
	efo	4.75926	20	0.23796	0.95	0.5342	0.5333	0.5342
2	ERROR	9.00000	36	0.25000				
	trial	0.11574	1	0.11574	0.93	0.3487		
	tf	0.48148	2	0.24074	1.93	0.1746		
	to	0.57870	5	0.11574	0.93	0.4871		
	tfo	1.74074	10	0.17407	1.39	0.2596		
3	ERROR	2.25000	18	0.12500				
	et	0.17593	2	0.08796	1.06	0.3585	0.3406	0.3585
	etf	0.51852	4	0.12963	1.56	0.2072	0.2253	0.2072
	eto	0.71296	10	0.07130	0.86	0.5809	0.5552	0.5809
	etfo	0.92593	20	0.04630	0.56	0.9178	0.8767	0.9178
4	ERROR	3.00000	36	0.08333				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9730	1.0000
4	0.7152	1.0000

Analysis of Variance for Descriptor: SURPRISE

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	2.44907	1	2.44907	7.90	0.0116		
	feedb	0.12037	2	0.06019	0.19	0.8253		
	order	1.13426	5	0.22685	0.73	0.6092		
	fo	5.21296	10	0.52130	1.68	0.1622		
1	ERROR	5.58333	18	0.31019				
	express	0.17593	2	0.08796	0.61	0.5473	0.5462	0.5473
	ef	0.29630	4	0.07407	0.52	0.7243	0.7231	0.7243
	eo	2.65741	10	0.26574	1.85	0.0862	0.0869	0.0862
	efo	1.70370	20	0.08519	0.59	0.8916	0.8907	0.8916
2	ERROR	5.16667	36	0.14352				
	trial	0.04167	1	0.04167	1.29	0.2717		
	tf	0.08333	2	0.04167	1.29	0.3007		
	to	0.09722	5	0.01944	0.60	0.7006		
	tfo	1.02778	10	0.10278	3.17	0.0160		
3	ERROR	0.58333	18	0.03241				
	et	0.19444	2	0.09722	1.62	0.2129	0.2157	0.2129
	etf	0.22222	4	0.05556	0.92	0.4613	0.4546	0.4613
	eto	0.75000	10	0.07500	1.25	0.2965	0.3028	0.2965
	etfo	1.33333	20	0.06667	1.11	0.3837	0.3881	0.3837
4	ERROR	2.16667	36	0.06019				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9928	1.0000
4	0.8989	1.0000

Analysis of Variance for Descriptor: FEAR

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	0.04167	1	0.04167	0.22	0.6450		
	feedb	0.02778	2	0.01389	0.07	0.9297		
	order	1.15278	5	0.23056	1.21	0.3422		
	fo	4.86111	10	0.48611	2.56	0.0397		
1	ERROR	3.41667	18	0.18981				
	express	0.36111	2	0.18056	0.95	0.3958	0.3790	0.3958
	ef	0.27778	4	0.06944	0.37	0.8313	0.7887	0.8313
	eo	3.02778	10	0.30278	1.60	0.1477	0.1708	0.1477
	efo	7.50000	20	0.37500	1.98	0.0368	0.0550	0.0368
2	ERROR	6.83333	36	0.18981				
	trial	0.04167	1	0.04167	0.36	0.5560		
	tf	0.08333	2	0.04167	0.36	0.7026		
	to	0.70833	5	0.14167	1.22	0.3383		
	tfo	1.91667	10	0.19167	1.66	0.1689		
3	ERROR	2.08333	18	0.11574				
	et	0.02778	2	0.01389	0.43	0.6547	0.5910	0.6547
	etf	0.22222	4	0.05556	1.71	0.1682	0.1901	0.1682
	eto	0.47222	10	0.04722	1.46	0.1959	0.2250	0.1959
	etfo	0.77778	20	0.03889	1.20	0.3087	0.3317	0.3087
4	ERROR	1.16667	36	0.03241				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.7929	1.0000
4	0.7206	1.0000

Analysis of Variance for Descriptor: ANGRY

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	7.40741	1	7.40741	15.69	0.0009		
	feedb	1.37037	2	0.68519	1.45	0.2605		
	order	2.53704	5	0.50741	1.07	0.4070		
	fo	4.18519	10	0.41852	0.89	0.5626		
1	ERROR	8.50000	18	0.47222				
	express	6.78704	2	3.39352	9.05	0.0007 *	0.0031	0.0007
	ef	1.18519	4	0.29630	0.79	0.5393	0.4998	0.5393
	eo	6.26852	10	0.62685	1.67	0.1260	0.1646	0.1260
	efo	4.25926	20	0.21296	0.57	0.9097	0.8605	0.9097
2	ERROR	13.50000	36	0.37500				
	trial	0.07407	1	0.07407	0.89	0.3583		
	tf	0.03704	2	0.01852	0.22	0.8029		
	to	0.09259	5	0.01852	0.22	0.9482		
	tfo	0.29630	10	0.02963	0.36	0.9508		
3	ERROR	1.50000	18	0.08333				
	et	0.12037	2	0.06019	0.48	0.6218	0.5637	0.6218
	etf	0.35185	4	0.08796	0.70	0.5946	0.5543	0.5946
	eto	0.71296	10	0.07130	0.57	0.8268	0.7788	0.8268
	etfo	2.31481	20	0.11574	0.93	0.5615	0.5475	0.5615
4	ERROR	4.50000	36	0.12500				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.5779	1.0000
4	0.7275	1.0000

* Significant at adjusted alpha .008

Analysis of Variance for Descriptor: SAD

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	0.78241	1	0.78241	1.35	0.2601		
	feedb	0.34259	2	0.17130	0.30	0.7473		
	order	3.63426	5	0.72685	1.26	0.3250		
	fo	5.65741	10	0.56574	0.98	0.4945		
1	ERROR	10.41667	18	0.57870				
	express	0.84259	2	0.42130	0.85	0.4356	0.4351	0.4356
	ef	1.15741	4	0.28935	0.58	0.6761	0.6753	0.6761
	eo	2.99074	10	0.29907	0.60	0.8001	0.7993	0.8001
	efo	7.84259	20	0.39213	0.79	0.7062	0.7056	0.7062
2	ERROR	17.83333	36	0.49537				
	trial	0.56019	1	0.56019	4.84	0.0411		
	tf	0.06481	2	0.03241	0.28	0.7590		
	to	1.18981	5	0.23796	2.06	0.1189		
	tfo	1.60185	10	0.16019	1.38	0.2633		
3	ERROR	2.08333	18	0.11574				
	et	0.00926	2	0.00463	0.04	0.9608	0.9587	0.9608
	etf	0.49074	4	0.12269	1.06	0.3904	0.3899	0.3904
	eto	1.15741	10	0.11574	1.00	0.4618	0.4614	0.4618
	etfo	2.17593	20	0.10880	0.94	0.5467	0.5459	0.5467
4	ERROR	4.16667	36	0.11574				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9947	1.0000
4	0.9796	1.0000

Appendix H

Means and Standard Deviations: Self-Report Change Scores

Cell Means for Descriptor: SURPRISE

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.0	0.0	0.0	0.50000	0.0	0.50000	0.0	0.0	0.50000
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.50000	0.0	0.50000
Frown T1:	0.0	0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.50000
Frown T2:	0.0	0.0	0.50000	0.0	0.0	0.50000	0.0	0.0	0.50000
Contr.T1:	0.0	0.0	0.0	0.50000	0.0	0.50000	0.0	0.0	0.0
Contr.T2:	0.0	0.50000	0.0	0.50000	0.0	0.50000	0.0	0.0	0.0
MARGINAL	0.0	0.16667	0.08333	0.25000	0.0	0.33333	0.08333	0.0	0.33333

Feedback = / Order =	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.0	0.0	0.0	0.0	0.0	0.0	1.00000	0.0	0.0
Smile T2:	0.0	0.0	-0.50000	0.0	0.0	0.0	1.00000	0.0	0.0
Frown T1:	-0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T2:	-0.50000	0.50000	0.0	0.0	0.0	0.0	0.50000	0.0	0.0
Contr.T1:	0.50000	0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.0	0.50000	0.0	0.0	0.0	0.0	1.00000	0.0	0.0
MARGINAL	-0.08333	0.25000	-0.08333	0.0	0.0	0.0	0.58333	0.0	0.0

	MARGINAL
Smile T1:	0.13889
Smile T2:	0.08333
Frown T1:	0.02778
Frown T2:	0.11111
Contr.T1:	0.11111
Contr.T2:	0.16667

Standard Deviations for Descriptor: SURPRISE

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.0	0.0	0.0	0.70711	0.0	0.70711	0.0	0.0	0.70711
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.70711	0.0	0.70711
Frown T1:	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.70711
Frown T2:	0.0	0.0	0.70711	0.0	0.0	0.70711	0.0	0.0	0.70711
Contr.T1:	0.0	0.0	0.0	0.70711	0.0	0.70711	0.0	0.0	0.0
Contr.T2:	0.0	0.70711	0.0	0.70711	0.0	0.70711	0.0	0.0	0.0

feedb = / order =	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.0	0.0	1.41421	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T2:	0.70711	0.70711	0.0	0.0	0.0	0.0	0.70711	0.0	0.0
Contr.T1:	0.70711	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cell Means for Descriptor: FEAR

Feedback	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.50000	0.0	0.0	0.0	0.0	-0.50000	0.0	0.0	-0.50000
Smile T2:	0.0	0.0	0.50000	0.50000	0.0	-0.50000	0.0	0.0	-0.50000
Frown T1:	-1.50000	0.0	0.0	0.0	0.0	0.50000	0.0	0.0	-0.50000
Frown T2:	-1.50000	0.0	0.0	0.50000	0.0	0.50000	0.50000	0.0	-0.50000
Contr.T1:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	-0.50000	0.0	0.50000	0.0	0.0	0.0	0.0	0.0	0.0
MARGINAL	-0.50000	0.0	0.16667	0.16667	0.0	0.0	0.08333	0.0	-0.33333

Feedback	mirr	mirr	mirr	self	self	self	self	self	self
Order	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T2:	0.0	-0.50000	0.50000	0.0	0.0	0.0	-0.50000	0.0	0.0
Contr.T1:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.50000	-0.50000	1.00000	0.0	0.0	0.0	0.0	0.0	0.0
MARGINAL	0.08333	-0.08333	0.25000	0.0	0.0	0.0	-0.08333	0.0	0.0

	MARGINAL
Smile T1:	0.00000
Smile T2:	0.00000
Frown T1:	-0.08333
Frown T2:	-0.05556
Contr.T1:	0.00000
Contr.T2:	0.05556

Standard Deviations for Descriptor: FEAR

feedb	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
order	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.70711	0.0	0.0	0.0	0.0	0.70711	0.0	0.0	0.70711
Smile T2:	0.0	0.0	0.70711	0.70711	0.0	0.70711	0.0	0.0	0.70711
Frown T1:	0.70711	0.0	0.0	0.0	0.0	0.70711	0.0	0.0	0.70711
Frown T2:	0.70711	0.0	0.0	0.70711	0.0	0.70711	0.70711	0.0	0.70711
Contr.T1:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.70711	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0

feedb	mirr	mirr	mirr	self	self	self	self	self	self
order	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.0	0.0	0.0	0.0	0.0	0.0	1.41421	0.0	0.0
Frown T2:	0.0	0.70711	0.70711	0.0	0.0	0.0	0.70711	0.0	0.0
Contr.T1:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.70711	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cell Means for Descriptor: HAPPY

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	-1.00000	0.50000	1.00000	-1.00000	0.0	0.50000	0.50000	-0.50000	0.50000
Smile T1:	-1.00000	1.00000	-0.50000	0.0	0.0	-0.50000	1.00000	-0.50000	0.50000
Frown T1:	0.0	1.00000	-1.00000	-0.50000	-0.50000	-0.50000	-0.50000	0.0	-0.50000
Frown T2:	0.0	0.50000	-0.50000	-0.50000	-0.50000	-0.50000	-1.00000	0.0	0.0
Contr.T1:	-0.50000	0.0	-1.00000	-1.00000	-0.50000	0.0	-0.50000	0.0	-0.50000
Contr.T2:	0.0	0.50000	-0.50000	-0.50000	-0.50000	0.0	0.0	0.0	-0.50000
MARGINAL	-0.41667	0.58333	-0.41667	-0.58333	-0.33333	-0.16667	-0.08333	-0.16667	-0.08333

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.50000	-0.50000	0.0	1.00000	0.0	0.0	0.50000	0.50000	0.0
Smile T1:	0.50000	-0.50000	0.50000	2.00000	0.0	0.0	0.0	0.50000	0.0
Frown T1:	-0.50000	-0.50000	-1.00000	0.0	-0.50000	-0.50000	0.0	0.0	-1.00000
Frown T2:	-1.00000	-0.50000	-0.50000	0.0	-0.50000	-0.50000	-0.50000	0.0	-1.00000
Contr.T1:	0.0	-0.50000	0.50000	-0.50000	0.50000	-0.50000	-0.50000	0.0	-0.50000
Contr.T2:	-0.50000	-1.00000	0.0	-1.00000	0.50000	-0.50000	-0.50000	0.0	0.0
MARGINAL	-0.16667	-0.58333	-0.08333	0.25000	0.0	-0.33333	-0.16667	0.16667	-0.41667

	MARGINAL
Smile T1:	0.13889
Smile T1:	0.16667
Frown T1:	-0.36111
Frown T2:	-0.38889
Contr.T1:	-0.30556
Contr.T2:	-0.25000

Standard Deviations for Descriptor: HAPPY

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.0	0.70711	1.41421	0.0	0.0	0.70711	0.70711	0.70711	0.70711
Smile T1:	0.0	1.41421	0.70711	1.41421	0.0	0.70711	1.41421	0.70711	0.70711
Frown T1:	0.0	0.0	1.41421	0.70711	0.70711	0.70711	0.70711	0.0	0.70711
Frown T2:	0.0	0.70711	2.12132	2.12132	0.70711	0.70711	1.41421	0.0	0.0
Contr.T1:	0.70711	0.0	0.0	1.41421	0.70711	1.41421	0.70711	0.0	0.70711
Contr.T2:	1.41421	0.70711	0.70711	0.70711	0.70711	0.0	0.0	0.0	0.70711

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.70711	0.70711	1.41421	0.0	0.0	0.0	0.70711	0.70711	0.0
Smile T1:	0.70711	0.70711	2.12132	0.0	0.0	0.0	0.0	0.70711	1.41421
Frown T1:	0.70711	0.70711	0.0	0.0	0.70711	0.70711	0.0	0.0	0.0
Frown T2:	0.0	0.70711	0.70711	0.0	0.70711	0.70711	2.12132	0.0	0.0
Contr.T1:	0.0	2.12132	0.70711	0.70711	0.70711	0.70711	0.70711	0.0	0.70711
Contr.T2:	0.70711	1.41421	0.0	0.0	0.70711	0.70711	0.70711	0.0	1.41421

Cell Means for Descriptor: DISGUSTED

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	1.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	1.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	1.00000	0.0	0.0	0.50000	0.0	0.0	0.0	0.0	0.0
Frown T2:	1.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T1:	1.00000	0.0	0.0	0.0	0.0	0.50000	0.0	0.50000	0.0
Contr.T2:	0.50000	0.0	0.0	-0.50000	0.0	0.0	0.0	0.50000	0.0
MARGINAL	1.00000	0.0	0.0	0.0	0.0	0.08333	0.0	0.16667	0.0

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	0.50000	1.00000	-0.50000	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.0	-0.50000	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.0	0.50000	0.50000	0.0	0.0	0.0	0.50000	0.0	1.00000
Frown T2:	0.50000	0.0	0.0	0.50000	0.0	0.0	0.0	0.0	1.00000
Contr.T1:	0.0	0.50000	0.50000	0.50000	0.0	0.0	0.0	0.0	0.50000
Contr.T2:	0.50000	1.00000	0.0	1.00000	0.0	0.0	0.50000	0.50000	0.50000
MARGINAL	0.16667	0.41667	0.33333	0.16667	0.0	0.0	0.16667	0.08333	0.50000

	MARGINAL
Smile T1:	0.13889
Smile T2:	0.02778
Frown T1:	0.22222
Frown T2:	0.16667
Contr.T1:	0.22222
Contr.T2:	0.25000

Standard Deviations for Descriptor: DISGUSTED

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.0	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	0.0
Frown T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T1:	0.0	0.0	0.0	0.0	0.0	0.70711	0.0	0.70711	0.0
Contr.T2:	0.70711	0.0	0.0	0.70711	0.0	0.0	0.0	0.70711	0.0

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	0.70711	0.0	0.70711	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.0	0.70711	0.70711	0.0	0.0	0.0	0.70711	0.0	1.41421
Frown T2:	0.70711	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	1.41421
Contr.T1:	0.0	0.70711	0.70711	0.70711	0.0	0.0	0.0	0.0	0.70711
Contr.T2:	0.70711	1.41421	0.0	1.41421	0.0	0.0	0.70711	0.70711	0.70711

Cell Means for Descriptor: ANGRY

Feedback / Order	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.50000	0.0
Smile T2:	0.0	0.0	0.0	0.0	0.0	-0.50000	0.0	0.0	0.0
Frown T1:	0.0	0.0	0.50000	0.50000	-0.50000	0.50000	0.0	0.0	1.00000
Frown T2:	1.00000	0.0	0.0	0.0	-0.50000	1.00000	0.0	0.0	1.00000
Contr.T1:	0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARGINAL	0.33333	0.0	0.08333	0.08333	-0.16667	0.16667	0.0	0.08333	0.33333

Feedback / Order	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.0	0.0	-0.50000	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	-0.50000	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.50000	0.50000	1.00000	1.00000	0.0	0.0	1.00000	0.50000	1.50000
Frown T2:	0.50000	0.0	0.50000	1.00000	0.0	0.0	1.00000	0.50000	1.00000
Contr.T1:	0.50000	0.50000	0.0	0.0	0.0	0.0	0.50000	0.0	0.50000
Contr.T2:	0.50000	0.50000	0.50000	0.50000	0.0	0.0	0.50000	0.0	0.50000
MARGINAL	0.33333	0.25000	0.16667	0.41667	0.0	0.0	0.50000	0.16667	0.58333

	MARGINAL
Smile T1:	0.02778
Smile T2:	-0.05556
Frown T1:	0.44444
Frown T2:	0.38889
Contr.T1:	0.13889
Contr.T2:	0.16667

Standard Deviations for Descriptor: ANGRY

feedb / order	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.70711	0.0
Smile T2:	0.0	0.0	0.0	0.0	0.0	0.70711	0.0	0.0	0.0
Frown T1:	0.0	0.0	0.70711	0.70711	0.70711	0.70711	0.0	0.0	1.41421
Frown T2:	1.41421	0.0	0.0	0.0	0.70711	1.41421	0.0	0.0	1.41421
Contr.T1:	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contr.T2:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

feedb / order	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0
Frown T1:	0.70711	0.70711	1.41421	0.0	0.0	0.0	0.0	0.70711	0.70711
Frown T2:	0.70711	0.0	0.70711	0.0	0.0	0.0	1.41421	0.70711	1.41421
Contr.T1:	0.70711	0.70711	0.0	0.0	0.0	0.0	0.70711	0.0	0.70711
Contr.T2:	0.70711	0.70711	0.70711	0.70711	0.0	0.0	0.70711	0.0	0.70711

Cell Means for Descriptor: SAD

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o5	o1	o2	o3
Smile T1:	0.0	-0.50000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smile T2:	0.0	-0.50000	0.0	0.50000	0.0	0.0	0.0	0.0	0.0
Frown T1:	-1.00000	0.0	0.0	-0.50000	0.0	0.50000	0.0	-0.50000	0.50000
Frown T2:	-0.50000	0.0	-0.50000	0.0	0.0	1.00000	0.0	-0.50000	0.0
Contr.T1:	-0.50000	0.0	0.0	-0.50000	0.0	1.00000	0.0	0.50000	0.0
Contr.T2:	-1.00000	0.0	0.50000	-0.50000	0.0	0.50000	0.0	0.0	0.0
MARGINAL	-0.50000	-0.16667	0.0	-0.16667	0.0	0.50000	0.0	-0.08333	0.08333

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o6	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	-1.00000	0.0	-0.50000	-0.50000	0.0	-0.50000	-0.50000	0.0
Smile T2:	0.50000	0.0	0.0	-0.50000	-0.50000	0.0	-0.50000	-0.50000	0.0
Frown T1:	0.0	-0.50000	0.0	0.50000	-0.50000	0.0	0.50000	-0.50000	-0.50000
Frown T2:	0.50000	0.0	0.0	0.0	-0.50000	0.0	0.50000	0.0	0.0
Contr.T1:	0.0	-0.50000	0.0	0.0	0.0	0.0	0.0	0.0	-0.50000
Contr.T2:	0.0	0.0	0.50000	0.50000	0.0	0.0	-0.50000	0.50000	0.50000
MARGINAL	0.16667	-0.33333	0.08333	0.0	-0.33333	0.0	-0.08333	-0.16667	-0.08333

	MARGINAL
Smile T1:	-0.19444
Smile T2:	-0.08333
Frown T1:	-0.11111
Frown T2:	0.00000
Contr.T1:	-0.02778
Contr.T2:	0.05556

Standard Deviations for Descriptor: SAD

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.0	0.70711	0.0	1.41421	0.0	1.41421	0.0	0.0	0.0
Smile T2:	0.0	0.70711	0.0	0.70711	0.0	1.41421	0.0	0.0	0.0
Frown T1:	1.41421	0.0	1.41421	0.70711	0.0	0.70711	0.0	0.70711	0.70711
Frown T2:	0.70711	0.0	0.70711	1.41421	0.0	0.0	0.0	0.70711	0.0
Contr.T1:	0.70711	0.0	0.0	0.70711	0.0	0.0	0.0	0.70711	0.0
Contr.T2:	1.41421	0.0	0.70711	0.70711	0.0	0.70711	0.0	0.0	0.0

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.0	0.0	0.0	0.70711	0.70711	0.0	0.70711	0.70711	0.0
Smile T2:	0.70711	0.0	0.0	0.70711	0.70711	0.0	0.70711	0.70711	0.0
Frown T1:	0.0	0.70711	0.0	0.70711	0.70711	0.0	0.70711	0.70711	0.70711
Frown T2:	0.70711	0.0	0.0	0.0	0.70711	0.0	0.70711	0.0	0.0
Contr.T1:	0.0	0.70711	0.0	0.0	0.0	0.0	0.0	0.0	0.70711
Contr.T2:	0.0	0.0	0.70711	0.70711	0.0	0.0	0.70711	0.70711	0.70711

<u>Appendix I</u>

Means and Standard Deviations: Change Scores for Physiological Indices

Cell Means for: RESPIRATION

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.00778	-0.02080	-0.04452	-0.01826	-0.10667	0.04064	-0.10401	0.07165	0.06566
Smile T2:	-0.02218	0.02272	-0.07783	0.01090	-0.08811	-0.07034	0.09190	-0.01636	0.00796
Frown T1:	0.01972	-0.12617	0.01919	-0.11338	0.04301	-0.00074	0.01776	-0.12925	-0.07133
Frown T2:	0.04645	-0.06509	-0.08606	-0.07550	0.00536	-0.10539	-0.00405	-0.00653	-0.03338
Contr.T1:	-0.05842	-0.01553	0.03457	0.04943	-0.09810	-0.03672	0.28216	-0.09747	0.01660
Contr.T2:	-0.05303	-0.01669	-0.01956	0.02727	-0.05998	-0.10446	0.03740	0.06151	-0.07317
MARGINAL	-0.00995	-0.03693	-0.02903	-0.01992	-0.05075	-0.04617	0.05353	-0.01941	-0.01461

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	-0.12364	-0.02059	-0.13376	0.13184	-0.05957	-0.12270	0.03963	-0.05765	-0.02441
Smile T2:	-0.13788	-0.04428	-0.07541	0.02623	-0.03872	0.04276	-0.10933	-0.00703	-0.08989
Frown T1:	-0.22008	-0.00685	-0.19068	-0.00951	-0.02092	0.12630	0.00866	-0.07543	-0.10488
Frown T2:	-0.13115	-0.04254	-0.20951	-0.03538	-0.01987	0.08308	-0.01270	-0.06949	-0.09813
Contr.T1:	-0.05592	-0.06518	-0.28159	-0.04104	-0.00457	0.02621	-0.00767	0.00096	-0.11247
Contr.T2:	-0.03782	-0.10120	-0.20680	-0.08273	0.02275	-0.21664	0.00348	-0.09359	-0.06064
MARGINAL	-0.11775	-0.04677	-0.18296	-0.00176	-0.02015	-0.01016	-0.01299	-0.05037	-0.08174

	MARGINAL
Smile T1:	-0.02153
Smile T2:	-0.03778
Frown T1:	-0.05333
Frown T2:	-0.05291
Contr.T1:	-0.03641
Contr.T2:	-0.05202

Standard Deviaions for: RESPIRATION

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.08368	0.15655	0.03202	0.00245	0.12541	0.06868	0.0	0.13109	0.00896
Smile T2:	0.18328	0.06523	0.14172	0.10141	0.00314	0.06342	0.0	0.11617	0.02141
Frown T1:	0.01041	0.01939	0.06175	0.23181	0.22852	0.12340	0.0	0.15053	0.01162
Frown T2:	0.14759	0.04364	0.01323	0.20279	0.26735	0.02860	0.0	0.24068	0.12292
Contr.T1:	0.04469	0.02851	0.08389	0.04791	0.06059	0.19645	0.0	0.08701	0.05837
Contr.T2:	0.19426	0.04577	0.06552	0.05587	0.02392	0.11745	0.0	0.04902	0.05543

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.10302	0.15453	0.02334	0.11079	0.14676	0.0	0.19684	0.00013	0.22324
Smile T2:	0.12406	0.10478	0.02557	0.13100	0.23419	0.0	0.08384	0.12567	0.16995
Frown T1:	0.33307	0.10159	0.14266	0.05690	0.01837	0.0	0.04093	0.02656	0.05436
Frown T2:	0.12291	0.05041	0.06936	0.12163	0.08046	0.0	0.03896	0.11230	0.06576
Contr.T1:	0.22449	0.01634	0.08071	0.08463	0.09932	0.0	0.00994	0.03396	0.15133
Contr.T2:	0.21268	0.13767	0.10912	0.07675	0.33076	0.0	0.08183	0.13235	0.14515

Cell Means for: MUSCLE TENSION - RIGHT ARM

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.01586	0.07487	0.06368	0.04822	0.01314	0.04129	0.10651	0.46194	-0.39956
Smile T2:	0.01273	0.11370	0.18017	0.02212	-0.03513	0.01451	0.31185	0.70894	-0.04885
Frown T1:	0.07738	0.07619	-0.06071	0.39835	0.00124	-0.10880	0.26720	0.42912	0.11102
Frown T2:	-0.02186	0.19377	0.01593	0.11160	-0.14716	-0.03383	0.22828	0.08407	0.33938
Contr.T1:	0.37625	-0.17517	0.17170	-0.66987	-0.60905	-0.00048	0.08842	0.42835	0.67620
Contr.T2:	0.10691	0.24666	0.39520	-0.76804	-0.61346	-0.00504	-0.12405	0.57579	0.03259
MARGINAL	0.09454	0.08834	0.12766	-0.14293	-0.21507	-0.01539	0.14637	0.44803	0.11846

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.12857	0.80025	0.11980	0.01591	0.29762	-0.33344	-0.19983	0.02449	-0.01549
Smile T2:	0.13467	0.55369	0.15261	0.07779	0.30915	-0.11644	-0.35938	-0.12558	0.33727
Frown T1:	1.13359	-0.34293	0.71015	0.22377	0.11726	-0.13778	0.02950	0.17150	-0.13699
Frown T2:	0.72656	0.21908	0.08046	0.10827	0.06307	0.23230	-0.12064	0.13416	0.01192
Contr.T1:	1.03590	0.42921	-0.23232	-0.09211	0.01384	-0.39285	0.05566	-0.07949	-0.20746
Contr.T2:	1.03700	0.37754	-0.42144	0.02348	-0.06750	-0.46670	-0.14772	0.12416	-0.01664
MARGINAL	0.69938	0.33947	0.06821	0.05952	0.12224	-0.20248	-0.12374	0.04154	-0.00456

	MARGINAL
Smile T1:	0.08102
Smile T2:	0.12624
Frown T1:	0.17026
Frown T2:	0.11736
Contr.T1:	0.06288
Contr.T2:	0.03436

Standard Deviations for: MUSCLE TENSION - RIGHT ARM

Feedback =	demo	demo	demo	demo	demo	demo	mirr	mirr	mirr
Order =	o1	o2	o3	o4	o5	o6	o1	o2	o3
Smile T1:	0.03889	0.05951	0.08382	0.09427	0.76829	0.05890	0.0	0.14021	0.60001
Smile T1:	0.00026	0.04331	0.11262	0.33180	0.70003	0.01809	0.0	0.31021	0.33914
Frown T1:	0.00571	0.04690	0.36436	0.09801	0.23171	0.14876	0.0	0.65436	0.04112
Frown T2:	0.16193	0.10895	0.21304	0.14480	0.50701	0.03810	0.0	0.13797	0.46049
Contr.T1:	0.05115	0.03148	0.04419	0.35946	0.59161	0.00440	0.0	0.57366	0.59060
Contr.T2:	0.27156	0.28000	0.18018	0.29275	0.83381	0.00497	0.0	0.18175	0.04398

Feedback =	mirr	mirr	mirr	self	self	self	self	self	self
Order =	o4	o5	o6	o1	o2	o3	o4	o5	o6
Smile T1:	0.00201	0.89902	0.10296	0.13000	0.14762	0.0	0.05725	0.54748	0.28402
Smile T1:	0.28276	0.47353	0.31514	0.37143	0.19915	0.0	0.15000	0.34043	0.08878
Frown T1:	0.54324	1.36233	0.42034	0.04544	0.00962	0.0	0.49193	0.03948	1.28652
Frown T2:	0.67802	0.67700	0.18371	0.05340	0.06270	0.0	0.01991	0.31445	1.44618
Contr.T1:	0.31623	0.04162	0.94667	0.14028	0.16617	0.0	0.33691	0.01615	0.64258
Contr.T2:	0.43558	0.20146	0.67972	0.37572	0.08724	0.0	0.46979	0.18989	0.05634

Cell Means for: MUSCLE TENSION - LEFT ARM

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	-0.06689	-0.32174	0.12408	0.13133	0.10074	0.00833	-0.02872	0.06541	-0.38110
Smile T2:	0.00290	-0.23033	0.02818	0.06091	0.26134	-0.04465	0.29974	-0.12454	-0.73898
Frown T1:	-0.03563	0.32525	0.48510	0.47795	0.17980	-0.38848	0.44291	0.15214	0.36299
Frown T2:	0.06463	0.42977	0.50741	0.28164	0.50608	-0.64970	-0.11324	0.22597	0.10486
Contr.T1:	0.03143	0.10463	0.48105	-0.52199	0.16390	0.02292	0.01629	0.26087	0.32067
Contr.T2:	-0.00586	0.27516	0.34605	-0.60932	0.13072	0.04324	-0.08535	0.17697	0.65033
MARGINAL	-0.00157	0.09712	0.32865	-0.02991	0.22376	-0.16804	0.08861	0.12614	0.05313

Feedback = / Order =	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.22579	0.56487	-0.14784	0.02148	0.08913	0.03287	-0.13194	0.15275	0.25716
Smile T2:	0.21556	0.48018	-0.18658	0.00252	0.21096	0.01035	-0.08560	0.01397	0.20653
Frown T1:	0.13886	0.22575	0.01584	0.25175	0.44908	-0.06285	0.16119	-0.08063	0.68931
Frown T2:	0.01322	0.31525	-0.14433	-0.02748	0.40816	0.19713	0.35212	-0.07871	0.51760
Contr.T1:	0.22272	0.43021	-0.07030	-0.02290	0.23464	0.05981	-0.12468	0.21189	0.15827
Contr.T2:	0.03155	0.65809	0.12818	-0.07818	-0.04503	0.01906	-0.01239	0.10637	0.32839
MARGINAL	0.14128	0.44573	-0.06750	0.02453	0.22449	0.04273	0.02645	0.05427	0.35953

	MARGINAL
Smile T1:	0.04080
Smile T2:	0.01338
Frown T1:	0.21178
Frown T2:	0.16872
Contr.T1:	0.11420
Contr.T2:	0.12301

Standard Deviations for: MUSCLE TENSION - LEFT ARM

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.13626	0.59197	0.16924	0.16271	0.14738	0.20222	0.0	0.70695	1.21160
Smile T2:	0.25349	0.65694	0.38631	0.12356	0.17622	0.42470	0.0	0.44721	0.96234
Frown T1:	0.21830	0.25285	0.07322	0.19104	0.14348	0.36504	0.0	0.11612	0.00358
Frown T2:	0.39216	0.37869	0.22263	0.29742	0.32997	0.45989	0.0	0.36438	0.35276
Contr.T1:	0.04377	0.10315	0.59468	0.33837	0.12766	0.53719	0.0	0.19263	0.46165
Contr.T2:	0.03448	0.27956	0.24969	0.39306	0.11507	0.67053	0.0	0.07634	0.49294

Feedback = / Order =	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.13867	0.07256	0.05666	0.43231	0.03586	0.0	0.12938	0.15044	0.61234
Smile T2:	0.39684	0.07734	0.13007	0.09551	0.38990	0.0	0.12627	0.04531	0.60664
Frown T1:	0.03969	0.32885	0.46605	0.00802	0.44790	0.0	0.38485	0.17530	0.12058
Frown T2:	0.12014	0.30525	0.19685	0.02009	0.38875	0.0	0.44225	0.14396	0.58301
Contr.T1:	0.50579	0.39952	0.09701	0.01850	0.19862	0.0	0.36265	0.35137	0.22444
Contr.T2:	0.13769	0.21756	0.08514	0.26147	0.40883	0.0	0.16297	0.36303	0.35295

Cell Means for: HEART RATE

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o5	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	-0.02155	0.00187	-0.00927	-0.01273	-0.02966	-0.00381	-0.00764	-0.02150	-0.01786
Smile T2:	0.00301	0.01850	-0.02439	0.00045	-0.03032	-0.00238	-0.01731	-0.00659	-0.02454
Frown T1:	-0.00536	0.00917	-0.00113	-0.03602	-0.01308	-0.00061	0.04924	-0.01979	-0.26277
Frown T2:	0.00326	0.03034	0.02702	-0.02495	-0.00513	0.01918	0.01526	0.00444	-0.03063
Contr.T1:	-0.01812	0.00958	-0.01423	-0.03175	-0.00720	0.00339	-0.09425	-0.00369	-0.03350
Contr.T2:	-0.03432	0.02817	0.00231	-0.01865	0.01132	0.02203	-0.05031	-0.01218	-0.02428
MARGINAL	-0.01218	0.01627	-0.00328	-0.02061	-0.01234	0.00630	-0.01750	-0.00972	-0.06560

Feedback = / Order =	mirr o4	mirr o5	mirr o6	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	-0.00861	-0.06890	0.01355	-0.00803	0.00910	-0.01768	0.01377	-0.01495	-0.03907
Smile T2:	0.01897	-0.04675	0.01148	0.00210	0.02387	-0.00201	0.02866	-0.03792	-0.03133
Frown T1:	-0.00197	-0.02536	-0.00847	-0.02027	0.00101	-0.00044	0.00461	0.00448	0.02973
Frown T2:	-0.00934	-0.02071	0.00710	-0.01171	0.01332	0.01217	0.01928	0.00870	0.01445
Contr.T1:	-0.01015	-0.00901	-0.02865	-0.01962	-0.00247	-0.06556	-0.00726	0.03003	-0.00676
Contr.T2:	-0.00839	0.01521	-0.00479	-0.00011	0.00194	-0.04397	0.01403	0.00296	0.00947
MARGINAL	-0.00325	-0.02592	-0.00163	-0.00961	0.00779	-0.01792	0.01218	-0.00112	-0.00375

	MARGINAL
Smile T1:	-0.01355
Smile T2:	-0.00623
Frown T1:	-0.01891
Frown T2:	0.00343
Contr.T1:	-0.01314
Contr.T2:	-0.00250

Standard Deviations for: HEART RATE

Feedback = / Order =	demo o1	demo o2	demo o3	demo o4	demo o6	demo o6	mirr o1	mirr o2	mirr o3
Smile T1:	0.00131	0.02428	0.00478	0.02183	0.01212	0.00974	0.0	0.04742	0.02294
Smile T2:	0.01266	0.02893	0.05204	0.01723	0.00277	0.01608	0.0	0.03046	0.01556
Frown T1:	0.04379	0.00768	0.01855	0.01015	0.01965	0.04584	0.0	0.03841	0.36410
Frown T2:	0.03160	0.00904	0.01882	0.03933	0.01418	0.06470	0.0	0.01605	0.06789
Contr.T1:	0.05834	0.00545	0.00449	0.00124	0.01417	0.02038	0.0	0.00569	0.02290
Contr.T2:	0.01675	0.00953	0.02026	0.02002	0.00773	0.01928	0.0	0.00928	0.02123

Feedback = / Order =	mirr o4	mirr o5	mirr o5	self o1	self o2	self o3	self o4	self o5	self o6
Smile T1:	0.03262	0.04330	0.01675	0.00435	0.00609	0.0	0.00268	0.04474	0.02723
Smile T2:	0.02449	0.02602	0.00414	0.00910	0.00227	0.0	0.01691	0.04688	0.03507
Frown T1:	0.00881	0.00959	0.02789	0.03204	0.00132	0.0	0.02653	0.00746	0.01992
Frown T2:	0.00930	0.00448	0.00006	0.03651	0.01822	0.0	0.01459	0.01760	0.01384
Contr.T1:	0.00812	0.01332	0.00433	0.02526	0.01575	0.0	0.00855	0.00341	0.02660
Contr.T2:	0.00771	0.00248	0.04217	0.02059	0.03063	0.0	0.01557	0.01636	0.02839

Repeated Measures Analysis of Variance: Physiological Indices

Analysis of Variance for: RESPIRATION

	SOURCE	SUM OF	DEGREES OF	MEAN	F	TAIL	GREENHOUSE PROB.	HUYNH PROB.
	MEAN	0.29223	1	0.29223	11.03	0.0043		
	feedb	0.02401	2	0.01201	0.45	0.6435		
	order	0.25098	5	0.05020	1.90	0.1514		
	fo	0.18533	10	0.01853	0.70	0.7123		
1	ERROR	0.42380	16	0.02649				
	express	0.01038	2	0.00519	0.19	0.8282	0.8258	0.8282
	ef	0.03110	4	0.00778	0.28	0.8861	0.8843	0.8861
	eo	0.11685	10	0.01169	0.43	0.9226	0.9212	0.9226
	efo	0.22567	20	0.01128	0.41	0.9796	0.9790	0.9796
2	ERROR	0.87594	32	0.02737				
	trial	0.00661	1	0.00661	2.46	0.1362		
	tf	0.00858	2	0.00429	1.60	0.2332		
	to	0.03369	5	0.00674	2.51	0.0736		
	tfo	0.04070	10	0.00407	1.52	0.2211		
3	ERROR	0.04297	16	0.00269				
	et	0.00684	2	0.00342	0.68	0.5135	0.5101	0.5135
	etf	0.00441	4	0.00110	0.22	0.9257	0.9222	0.9257
	eto	0.06891	10	0.00689	1.37	0.2371	0.2393	0.2371
	etfo	0.14202	20	0.00710	1.41	0.1863	0.1892	0.1863
4	ERROR	0.16070	32	0.00602				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.9886	1.0000
4	0.9748	1.0000

Analysis of Variance for: MUSCLE TENSION - RIGHT ARM

	SOURCE	SUM OF	DEGREES OF	MEAN	F	TAIL	GREENHOUSE PROB.	HUYNH PROB.
	MEAN	1.63269	1	1.63269	4.26	0.0557		
	feedb	4.25123	2	2.12561	5.54	0.0148		
	order	1.10199	5	0.22040	0.57	0.7186		
	fo	4.15648	10	0.41565	1.08	0.4272		
1	ERROR	6.13523	16	0.38345				
	express	0.39906	2	0.19953	0.75	0.4814	0.4425	0.4814
	ef	0.36531	4	0.09133	0.34	0.8473	0.7864	0.8473
	eo	1.99141	10	0.19914	0.75	0.6764	0.6387	0.6764
	efo	6.26990	20	0.31350	1.18	0.3335	0.3543	0.3335
2	ERROR	8.53527	32	0.26673				
	trial	0.00243	1	0.00243	0.06	0.8164		
	tf	0.06380	2	0.03190	0.73	0.4965		
	to	0.29097	5	0.05819	1.33	0.2996		
	tfo	0.52326	10	0.05233	1.20	0.3592		
3	ERROR	0.69746	16	0.04359				
	et	0.09223	2	0.04611	0.89	0.4191	0.4182	0.4191
	etf	0.12429	4	0.03107	0.60	0.6638	0.6622	0.6638
	eto	0.60684	10	0.06068	1.18	0.3421	0.3425	0.3421
	etfo	1.04826	20	0.05241	1.02	0.4722	0.4722	0.4722
4	ERROR	1.55111	32	0.05160				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.7173	1.0000
4	0.9895	1.0000

Analysis of Variance for: MUSCLE TENSION - LEFT ARM

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	2.32709	1	2.32709	9.97	0.0061		
	feedb	0.12377	2	0.06188	0.27	0.7704		
	order	1.16279	5	0.23256	1.00	0.4608		
	fo	3.54515	10	0.35451	1.52	0.2199		
1	ERROR	3.73383	16	0.23336				
	express	0.79100	2	0.39550	1.95	0.1583	0.1644	0.1583
	ef	0.44037	4	0.11009	0.54	0.7047	0.6836	0.7047
	eo	2.55801	10	0.25580	1.26	0.2912	0.2992	0.2912
	efo	3.51737	20	0.17587	0.87	0.6225	0.6136	0.6225
2	ERROR	6.47711	32	0.20241				
	trial	0.02071	1	0.02071	0.43	0.5207		
	tf	0.02615	2	0.01308	0.27	0.7651		
	to	0.06374	5	0.01275	0.27	0.9254		
	tfo	0.32584	10	0.03258	0.68	0.7295		
3	ERROR	0.76835	16	0.04802				
	et	0.02323	2	0.01161	0.32	0.7252	0.6971	0.7252
	etf	0.11121	4	0.02780	0.78	0.5484	0.6345	0.5484
	eto	0.41492	10	0.04149	1.16	0.3525	0.3572	0.3525
	etfo	0.51484	20	0.02574	0.72	0.7782	0.7618	0.7782
4	ERROR	1.14509	32	0.03578				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.8813	1.0000
4	0.8760	1.0000

Analysis of Variance for: HEART RATE

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB.	GREENHOUSE GEISSER PROB.	HUYNH FELDT PROB.
	MEAN	0.01572	1	0.01572	4.19	0.0573		
	feedb	0.01285	2	0.00642	1.71	0.2117		
	order	0.02245	5	0.00449	1.20	0.3541		
	fo	0.02567	10	0.00257	0.68	0.7244		
1	ERROR	0.05998	16	0.00375				
	express	0.00075	2	0.00038	0.16	0.8552	0.7768	0.8552
	ef	0.00366	4	0.00091	0.38	0.8198	0.7527	0.8198
	eo	0.02733	10	0.00273	1.14	0.3640	0.3737	0.3640
	efo	0.05031	20	0.00252	1.05	0.4392	0.4448	0.4392
2	ERROR	0.07661	32	0.00239				
	trial	0.00829	1	0.00829	6.65	0.0202		
	tf	0.00161	2	0.00081	0.65	0.5372		
	to	0.00416	5	0.00083	0.67	0.6536		
	tfo	0.00870	10	0.00087	0.70	0.7134		
3	ERROR	0.01994	16	0.00125				
	et	0.00151	2	0.00076	0.71	0.5005	0.4360	0.5005
	etf	0.00154	4	0.00038	0.36	0.8354	0.7398	0.8354
	eto	0.01186	10	0.00119	1.11	0.3845	0.3924	0.3845
	etfo	0.02153	20	0.00108	1.01	0.4801	0.4782	0.4801
4	ERROR	0.03419	32	0.00107				

EPSILON FACTORS FOR DEGREES OF FREEDOM ADJUSTMENT

ERROR TERM	GREENHOUSE-GEISSER	HUYNH-FELDT
2	0.6962	1.0000
4	0.6008	1.0000

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Reference Notes

Note 1:

The strain-guage transducer used to monitor respiration was developed by H.F. Gabert, P.Eng.,(1983) at Simon Fraser University, Psychology Department

Note 2:

The panel connected to the Nova 3D computer system which recorded subjective ratings of mood was developed by H.F. Gabert, P.Eng., (1985) at Simon Fraser University, Psychology Department

Note 3:

Software for the area/amplitude program was developed by H.F. Gabert, P.Eng.,(1980) at Simon Fraser University, Psychology Department