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THE EFFECT OF STRESS ON THE DECODER'S COMMUNICATION CHANNELS

by

Maureen Patricia Keeley

A Thesis Submitted to the Faculty of the

DEPARTMENT OF COMMUNICATION

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF ARTS

In the Graduate College

THE UNIVERSITY OF ARIZONA

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STATEMENT BY AUTHOR

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APPROVAL BY THESIS CO-DIRECTORS

This thesis has been approved on the date shown below:

Judee K. Burgoon — 7/3/87
Judee K. Burgoon — Date
Professor of Communication

William Bailey — 6/30/87
William Bailey — Date
Lecturer of Communication

DEDICATION

This thesis is dedicated to Mark, Patricia, Thomas, and Colleen.

To my fiance Mark Dyreson: Your direction, love, support friendship, assistance, alliance and faith was the foundation of this accomplishment. As in all things, we are a team, best friends and co-conspirators. You bring out the best in me!

To my mother Patricia Keeley: You showed us by example that we can have a family and a career, and for this I will be forever greatful. I chose my unique path to travel as you did.

To my father Thomas Keeley: You showed us by example that we must strive to be the best that we can be.

To my twin sister Colleen Keeley Thielen: You have always been there for me and always will be.

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Last but not least, I would like to thank my parents and family for their love, support, belief in me and for teaching me that "you can do anything if you want it bad enough, work hard enough and keep a positive attitude." Being the youngest has its advantages--I learned from all of you. I love you and thank you.

To my brother Jim—choosing one's own path isn't easy but it is worth it! Thank you for the example and support.

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ABSTRACT

This thesis investigated the interaction of stress and decoding accuracy through the vocalic and facial kinesic channels and with regard to gender. Stress (high and low) was created for 372 undergraduate students using the Stroop Color-Word Test. Overall, results did not show that an increase in stress lead to a decrease in decoding accuracy. However, the findings did suggest that stress was impacting on the decoding process. The researcher uncovered a main effect for channel such that the facial kinesic channel was the most accurate for decoding emotions. In addition, an ordinal interaction was found during the first time period which showed that stress was differentially affecting the four groups (kinesic, high and low stress; vocalic, high and low stress). Males and females were affected in a similar manner by stress, with females being consistently more accurate decoders than males regardless of the amount of stress or channel used.

CHAPTER 1

INTRODUCTION

Stress is a common experience in our society. Individuals feel stress in varying degrees of intensity and frequency depending on such complex factors as relational conflicts, role expectations, work, and school demands. The significant impact of stress on individuals' everyday lives and interactions makes it an important variable in communication.

For many years, scholars have explored stress within the scientific domain. The body of research on stress includes studies dealing with psychological and physiological responses, the causes of stress, and the methods of coping with stress. In all, well over 120,000 books and articles have been written on stress (Selye, 1979). One neglected area of research has been the impact of stress on communication.

Communication research, especially that on nonverbal and interpersonal communication, has attempted to examine many of the complex factors that affect the patterns of interactions, the impact of communication on people, and the variables that aid or deter successful dyadic transactions. Only a handful of articles related to stress and communication have been written within the

last ten years. The majority of those articles have dealt with communication as a skill to be used to lessen the harmful effects of stress.

One area worthy of examination is the role of stress on communication abilities of individuals in social interactions. Stress interferes with complex tasks (Siegman, 1978), affects cognitive processing (Buck, 1979b), increases the selectivity of attention, and decreases the primary memory capacity (Warburton, 1979). Buck (1983) emphasized that the ways in which people direct their attention to the multitude of cues in other persons are critical in determining the kinds of information they extract from their sources. He insisted that attention is the condition necessary for decoding, and the ability to decode communication cues should be affected by the amount of stress experienced by the interactants. Since decoding is a complex task involving perception and attention, stress should significantly distract individuals from the task of decoding interpersonal messages. There are increasing indications that interpersonal interactions are affected in substantial ways by an interactant's ability to decode verbal and nonverbal cues (Zuckerman & Larrance, 1979; Archer & Akert, 1977; Buck, 1980; Buck, 1983; Zuckerman & Rosenthal, 1979c; Burn & Beier, 1973; Furnham, Trevethan, & Gaskell, 1981; Mehrabian & Wiener, 1976). One area worthy of examination is the role of stress on communication abilities of individuals in social interactions.

Some impairment of decoding ability may account for the difficulty people have communicating with one another during periods of stress. In particular, research in this area may explain misunderstandings and conflicts in the workplace, the home and the political arena by revealing the impact of stress on individuals' decoding accuracy.

This study will examine the specific role of stress in the individual's ability to decode messages. Stress may introduce a systematic bias in individuals' channel preference and reliance. When involved in a stressful interaction, individuals may rely on the one specific channel in which they are most confident and in which they decode most accurately. Thus, this thesis will examine how stress affects the decoder's accuracy in judgments of emotion through two specific channels of nonverbal communication: facial kinesic cues and vocalic cues.

Models of Stress

Stress has been examined from both "sides" of the psychological stimulus-response model. The response based model describes stress in terms of the person's response to disturbing environments. Appley and Trumble (1967) noted response behaviors include any overt emotional reactions displayed through such things as vocalic nonfluencies as well as performance shifts. The stimulus based model examines stress in relation to the stimulus characteristics of the disturbing environment. Stimulus

characteristics were described as situations which were "new, intense, rapidly changing, sudden or unexpected, including (but not requiring) approach to the upper thresholds of tolerability" (Appley & Trumble, 1967, p. 5).

The organism-environment transactional model examines stress in terms of both its antecedent factors and its effects (Cox, 1978; McGrath, 1970). It is a more inclusive theory about stress than either the response or stimulus models of stress. The model describes stress as a "complex and dynamic system of transaction between the person and his environment" (Cox, p. 18). The transactional model, incorporating the strengths of each model, uses stress as an intervening variable between stimulus and response (Cox, 1978). The transactional model examines stress as a lack of fit between a person and the environment. The following definition and summary of the model are the foundation for the ensuing analysis:

> Stress, it is argued, can only be sensibly defined as a perceptual phenomenon arising from a comparison between the demand on the person and his ability to cope. An imbalance in this mechanism, when coping is important, gives rise to the experience of stress, and to stress response. The latter represent attempts at coping with the source of stress. Coping is both psychological (involving cognitive and behavioral strategies) and physiological. If normal coping is ineffective, stress is prolonged and abnormal responses may occur. (Cox, p. 25)

Cox's definition of stress emphasizes the fact that the phenomenon of stress is the result of an overly demanding task which will require effort on the individual's part; this effort will create

negative arousal in the individual and will result in the interference of the performance of the task.

Attentional Effects of Stress on Decoding Sensitivity

Buck's (1984) contention that individuals' centrality of attention will impact on the kinds of information they receive, highlights the need to examine the attentional effects of stress on decoding sensitivity. Mandler (1979), discussing the impact of stress on individuals' abilities to attend to cues, surmised that when stress takes an individual's autonomic activity past the point of alerting the individual, continuing arousal interferes with ongoing cognitive activity and acts as "noise". Further, he believed that with an increasing number of cues to attend to, attention would be limited. Bacon's (1974) study examining arousal and the range of cue utilization discovered that in states of stress, the range of cues processed is narrowed by systematically reducing responsiveness to the aspects of the situation which initially require a lesser degree of attention. Both studies attest to the fact that with stress comes a narrowing effect with regard to the number of things to which a person can successfully attend. The possible implications of the stress induced narrowing of attention for decoding research are great. To fully understand the potential impact of this narrowing of attention, a review of decoding literature, including the

information potential of the kinesic, facial and vocalic channels will be explored.

Nonverbal Sensitivity

More than a century of research examining the sensitivity of nonverbal behaviors began with Darwin's (1872) Expression of Emotions in Man and Animals. Darwin explored the nature and origins of emotional expression. One of the most puzzling, complex, and challenging aspects of the nature of emotional expressions is the analysis and understanding of individuals' decoding abilities (Ekman & Friesen, 1969). Scholars have discovered a great deal of knowledge about what affects individuals' decoding abilities. Four major factors have been found to account for individual levels of nonverbal receiving abilities. Buck (1984; 1983) outlined the four factors as the experience and skill of decoding in general, the decoding of nonverbal behaviors of someone unknown, nonverbal expressiveness of the receiver, and the degree of attention given to the nonverbal behaviors of others.

Research examining the issue of channel accuracy for detection of emotion and information is divided over the question of visual or auditory supremacy. To clarify the theoretical basis for these two opposing views, the research discussing the decoding of emotions through the kinesic, facial channel and the vocalic channel is reviewed.

Kinesic, Facial Channel

Investigators have produced a great deal of literature about the superiority of the kinesic channel over the other channels of nonverbal communication. The findings indicate six strengths that the kinesic, facial channel has for information as compared to the other nonverbal channels. The first strength stated by Buck (1980) is that the face gives more information to the decoders concerning the affective state of the individual. Berman, Shulman, and Morwit (1976) concurred with Buck that there is a difference in information given in each channel, with the facial channel providing more information for the decoder. Further, Ekman and Friesen's (1975) research has revealed that emotions are shown primarily in the face. Facial action has also been found to provide accurate information about different aspects of the subjective experience of emotion (Ekman, Friesen and Ancoli, 1980). Leathers and Emigh (1980) and Leathers (1986) have substantiated the importance of the face in decoding emotions. Both reports emphasize that facial expressions provide the decoder with extremely precise information about the communicator's emotional states and identified the face as the most important source of emotional information.

The second strength of the kinesic, facial channel is that the face gives the encoder greater control over the read-out of the emotion; thus, giving more intentional information to the decoder (Buck, 1980). Berman, Shulman, and Morwit (1976) noted

the third strength of the kinesic, facial channel: a difference in control in the decoding process. Berman et al. speculated that the decoder can quickly scan the face for information and then go back over the facial expression with greater concern for the more informative cues, whereas the decoder using the audio channel has to accept the sounds as they come and can only concentrate on those cues once. DiMatteo and Hall's (1979) findings revealed the fourth and fifth strengths of the visual channel of the face in that there is greater preference for and confidence in judgments of facial expressions by decoders. The sixth reason for superiority of the kinesic facial channel is that the voice has a greater alerting capacity which requires less effort and attention on the individual's part, which in turn causes individuals to focus on the face and expend more effort on catching facial cues, all which results with more practice and focus on the facial channel (Posner, Nissen, & Klein, 1976).

The results of several studies suggest that when the vocalic channel and the kinesic channel convey different affects, subjects will be much more influenced by the kinesic than by the vocalic cues (Mehrabian & Ferris, 1969; Bugental, Kaswan, & Love, 1970; DePaulo & Rosenthal, 1979a; 1979b; Rosenthal, 1979a). Faces showed greater variability in attitude expression than voices, showed greater independence from the explicit verbal channel, and appeared to be more important in interpersonal interactions than vocal cues (Zaidel & Mehrabian, 1969). Burns and Beier (1973)

established that visual cues are more influential and more accurate in their designation of a mood state than the vocalic channel. Finally, Gubar (1966) found that facial patterns have both spatial and temporal aspects, thus the face may give more general information than the vocalic channel.

Vocalic Channel

Many conclusions about the accuracy and importance of the vocalic channel for decoding abilities have emerged from research exploring deception. In the attempt to find the most effective means for detecting deception across transmission modes, scholars discovered that paralinguistic or vocalic cues are more useful in the detection of deception (which was described as stressful for the encoder) than the visual cues of the face or body (Streeter, Kraus, Olson, & Apple, 1977; Littlepage & Pineault, 1981). Hocking and Leathers (1983) asserted that deceivers would have the greatest difficulty exerting control and monitoring cues in the vocalic channel.

DePaulo, Rosenthal, Eisenstat, Rogers, and Finkelstein's (1978) study disclosed that decoders attended more to audio cues when exposed to more discrepant rather than less discrepant stimuli. Mehrabian and Wiener (1976) investigated inconsistent communication of attitude and determined that the variability of inferences about the communicator's attitude was made primarily on the basis of variations of the tone. The vocalic channel becomes

most important when decoding assertiveness, dominance, and anxiety (Burns & Beier, 1973; DePaulo et al., 1978; DePaulo & Rosenthal, 1979a; Zuckerman, Amidon, Bishop, & Pomerantz, 1982).

Gender

Literature dealing with decoding abilities has found gender to be a critical issue (Noeller, 1985). Gender has been an important variable throughout decoding studies, and past findings suggest that there is a significant difference in nonverbal sensitivity between males and females (Buck, 1976; Hall, 1979). Females have consistently been found to be superior decoders (Zuckerman, Hall, DeFrank, & Rosenthal, 1976; Zuckerman, Larrance, Hall, DeFrank, & Rosenthal, 1979b; Zuckerman, Lipts, Koivumaki, & Rosenthal, 1975; Fugita, Harper, & Wiens, 1980; Buck, Savin, Miller, & Caul, 1972; Leathers, 1986). Women's facilities at decoding nonverbal cues are most obvious when using both the visual and vocalic cues as opposed to using the visual channel alone (Hall, 1981). Further, if only one channel can be used, women are more adept when using the visual rather than the vocalic channel. Three reasons researchers give for gender differences in decoding abilities are the externalizer/internalizer theory, social roles and training for males and females, and differences in brain hemisphere specialization for males and females.

Externalizers are individuals who show overt expressions but experience few electrodermal responses; internalizers have the

opposite experiences. Researchers have theorized that males are predominantly internalizers while females are predominantly externalizers (Buck, 1979a; Buck, 1979b; Buck, Miller, & Caul, 1974). Scholars surmised that if there is a difference in decoding abilities based on the distinction of externalizing/internalizing, it would be that the externalizer is more aware of the nonverbal cues used to express emotions.

Differences in social roles and training have been put forward as a possible reason for differences in nonverbal sensitivity between males and females. The explanation given to support the theory dealt with the distinct display rules which govern the expressive behaviors of males and females. Males are taught to inhibit their overt behavior, while females are permitted, even encouraged, to show their emotions, to freely express their feelings, and to be sensitive to the nonverbal cues of others (Fugita et al., 1980). Hall (1979; 1978) agreed that the differences in decoding were related to gender roles, to the stereotyping of "femininity" and "masculinity".

A study by Safer (1981) found a major similarity and difference between males and females when examining the relationship of brain hemispheric specialization and decoding abilities. The similarity is that males and females generally demonstrated a substantial right hemisphere superiority for recognizing faces. The right hemisphere decodes information through its imagery codes for emotion; while the left hemisphere

predominantly decodes information through symbolic, verbal codes. The critical difference, however, is that males have limited access to verbal codes for decoding information which form the representation of an emotional expression; women do not have the same limitation. The differences in hemisphere specialization and possibly decoding abilities mean that emotional expressions can be decoded, especially by females, with the left and right hemispheres. It appears that males have the vocabulary and the emotional feelings but lack the skill necessary to connect words to the feelings.

These findings support significant difference between men and women in general decoding ability; they do not, however, address the question of whether stress differentially affects those abilities.

Hypotheses and Research Question

The independent research on stress and decoding ability leads to the following conclusions. Stress interferes with individuals' cognitive efficiency and limits the individuals' attention capabilities (Mandler, 1979). During periods of stress, the range of cues that are processed is narrowed (Bacon, 1974). Further, decoding abilities are dependent upon the degree of attention given to the nonverbal cues (Buck, 1984; 1983). Therefore, the following hypothesis is advanced:

H1: An increase in stress causes an individual's nonverbal decoding capabilities to decrease in accuracy.

Despite the conflicting research on channel accuracy, the kinesic channel is posited as the most accurate channel during a stressful situation for the following reasons. The kinesic, facial channel offers the most general and emotional information of any single channel (Buck, 1980; Berman, et al., 1976; Ekman & Friesen, 1975). The visual channel allows for greater control of the time and direction of attention towards the nonverbal cues as opposed to the limited, one time exposure of the vocalic channel (Berman, et al., 1976). Individuals have greater preference for and confidence in judgments of facial expressions (DiMatteo & Hall, 1979) and will especially depend upon this confidence during times of stress. Lastly, individuals consistently rely upon the kinesic channel because they are the most familiar with facial discrepancies (Rosenthal, 1979a; Rosenthal et al., 1979b).

Compared to studies of facial superiority, deception studies which note the vocalic channel as the most accurate channel for decoding during stressful action are not applicable in the stress induced situation of this study. The studies dealt with decoding the stressful deceiver rather than decoding emotions during stressful periods. Stress research in deception studies focuses upon the encoder (Ekman & Friesen, 1969). Further, scholars studying the vocalic channel have gathered most of the support for the vocalic channel's superiority by examining limited issues dealing with emotional intensity, anger, and anxiety, and have basically ignored the full range of emotions

(Burns & Beier, 1973; DePaulo, et al., 1978; DePaulo & Rosenthal, 1979b; Zuckerman, Amidon, Bishop, & Pomerantz, 1982). The deception studies, consequently, give but limited support for the contention that vocalics is the most accurate channel during stress and the emotional decoding of emotions. Therefore:

H2: In a stressful situation, there will be a main effect for channels such that the kinesic channel is the most accurate channel for decoding nonverbal cues.

H3: In a stressful situation, there will be an ordinal interaction such that the vocalic channel should be significantly more debilitated by high stress during time period one.

Past literature has cited gender as an important intervening variable in the study of decoding abilities. Findings support a significant difference between men and women in general decoding abilities such that women are consistently superior decoders (Zuckerman, Hall, DeFrank, & Rosenthal, 1976; Zuckerman, Larrance, Hall, DeFrank, & Rosenthal, 1979b; Zuckerman, Lipets, Koivumaki, & Rosenthal, 1975; Fugita, Harper, & Wiens, 1980; Buck, Savin, Miller, & Caul, 1972; Leathers, 1986). Therefore, the following hypothesis is advanced:

H4: Females show greater accuracy in decoding than males.

Research, however, dealing with stress has not examined it in conjunction with gender, nor has communication research examined the interaction of stress and decoding abilities with gender. A research question concerning gender as an intervening

variable and how it may be affected by the interaction of stress and decoding abilities has been developed:

Ra: Does stress differentially affect males and females?

CHAPTER 2

METHODOLOGY

Overview

The experiment examined respondents' decoding accuracy of video and audio channels under stressful and nonstressful conditions. Stress was manipulated through the use of a modification of the Stroop Color-Word Test, which was intermingled with presentations of kinesic or vocal emotional expressions. Subjects were asked to make a series of judgments about the color they were seeing when presented with a consistent (low stress) or conflicting (high stress) color choice, interspersed with identification of several kinesic or vocalic emotions. The State Trait Anxiety Test (STAI) (Spielberger, Gorsuch & Luchene, 1968), a self-evaluation tool, was administered twice during the fifteen minute experiment as a check on the stress manipulation.

Subjects

Subjects were 178 males and 194 females (N=372) enrolled in introductory level communication courses at the University of Arizona. Subjects participated in the experiment during class time or outside of class for extra credit. A demographic analysis of the subjects showed that 80 percent of the subjects were

between the ages of eighteen and twenty-one years. The mean age for the entire sample was 20.7 years. The racial background of the sample was primarily white (87 percent, while 7 percent were Hispanic, and 6 percent were black, Asiatic or another ethnic background).

Independent Variables

Two independent variables were manipulated during this experiment: stress (high or low) and channel (kinesic or vocalic). The Stroop Color-Word Test (Stroop, 1935), used to create and control the level of stress in the experiment, was originally designed to test individual differences in serial verbal reactions with interference. During the span of the last half century, the test has been used in a wide variety of studies and has shown significant correlations with a host of other, often more complex psychological measurements (Dyer, 1973). Specifically pertaining to this study, research cited the Stroop-Color Word Test as a stress inducer when conflicting colors, words, and audio were presented to the subjects (Jensen & Rohwer, 1966; Thurstone & Mellinger, 1953). Those studies found that when subjects were administered the conflicting color and world choice, they exhibited physical signs of tension with increased gesturing, exaggerated vocal emphasis, and even occasionally broke down into tense laughter in the midst of the test. The adaptability and flexibility of the Stroop Color-Word Test over the past fifty

years, with its consistent reliability and validity in over seventy studies, suggested its usefulness in communication research involving nonverbal decoding sensitivity.

The experimenter administered the color-word test using slides with one color and one word per slide, with twenty-six slides or audio segments per trial. The six colors used for this experiment are those most commonly used with the Stroop test (Stroop, 1935; Dyer, 1973); blue, green, purple, red, yellow, and black. Subjects were asked to make judgments of colors based on the color of the word.

The investigator created two levels of stress in the experiment (high and low). In the low stress groups, the subjects made evaluations of colors which were consistently portrayed to them. For example, if a student read the word RED on the screen, he or she would also see the color red and hear the word red at the same time. Intermixed with the colors were the facial, kinesic slides or the vocalic statements in one of six emotions. In the high stress groups, the subjects were asked to make exactly the same judgments in the same amount of time but with one major change. The color messages presented to the high stress groups were incongruent with each other. For example, if the student read the word RED, he or she would see red written in the color blue and hear the word yellow at the same time. The students would have to make an evaluation of the color they were seeing, not the color that they read or heard. Subjects recorded

judgments of color and emotion by circling the appropriate answer on an answer sheet specially prepared for the task (see Appendix C). The experimenter pretested the method of measurement during a pilot of the experiment.

The second independent variable was the nonverbal channel used by the subjects during the emotion decoding task. The vocalic only groups saw and heard the colors presented to them, just as the kinesic groups did. However, subjects' evaluations of emotion were made on the basis of the audio tape recording alone while viewing a blank slide on the screen. The kinesics groups heard silence during the display of the facial expression on the screen.

Dependent Variables

Measurement of each subject's judgment of emotional expressions (kinesically or vocalically) was recorded on an answer sheet titled The Communication Aptitude Test (see Appendix D), specifically prepared for this task. The subject circled the one emotion he or she believed was the most accurate interpretation of the six emotions listed. The judgments of emotion were made over three time periods, with ten judgments of emotion and twenty-six judgments of color recorded per two-minute session.

The emotions stimuli incorporated Ekman and Friesen's (1975) six established states of emotion (happy, sad, surprise, disgust, fear, and anger). The emotions were displayed via the

visual and audio channels through the mechanics of slides or cassette recordings. The slides used to test the kinesic, facial emotions were taken from pictures already tested for their validity (Ekman & Friesen, 1975). The specific facial photographs used in the experiment were taken from Ekman and Friesen's (1975) Unmasking the Face. These have been consistently found to represent the six primary emotions used.

The six emotional vocalic expressions were professionally produced by the University of Arizona Medical Center's Biomedical Communications Department. The vocalic expressions used in the experiment were made from recordings by eight Communication graduate students. The experimenter pretested the forty-eight vocalic expressions (six emotions by eight individuals) for accuracy. Voices which were rated to be obvious/accurate or too unobvious/inaccurate were not used. If the voices were easily recognized or were impossible to distinguish within a consistent range for each emotion, the impact of stress on decoding accuracy would have been more difficult to distinguish from the simplicity or complexity of the task. The following mean alpha reliabilities for each vocalic emotion in this study were: anger, .73; fear, .52; happiness, .79; sadness, .87; disgust, .55; and surprise, .81. The overall alpha reliability for the sensitivity scale was .59.

Procedures

The experiment was conducted over a two-week period in which groups of subjects ranging in number from five to thirty-five were tested. The groups were randomly assigned to one of four treatment groups: high stress kinesics (n=94), high stress vocalics (n=88), low stress kinesics (n=98), and low stress vocalics (n=92). The variance in group size was unavoidable and resulted from using subjects during class time and randomization of the groups. The overall large number of participants in the experiment (N=372) reduced the risk of unequal groups having a significant impact on the results. In addition a test for unequal cells established that the total deviation was less than one percent and therefore not affected by the different cell sizes.

In all four groups, the subjects were asked to fill out the State Trait Anxiety Test (Spielberger et al., 1968) prior to the commencement of the actual experiment to obtain a baseline assessment of general levels of stress. Each subject filled out the questionnaire a second time while the experiment was in progress to obtain an assessment of the change in stress level due to the manipulation. The State Trait Anxiety Test is the most widely used self-report test.

The experiment itself was divided into three, two-minute sessions. In the two-minute sessions, subjects had to evaluate thirty-six slides or segments of audio recordings per time period with a total of one-hundred and eight evaluations per trial. The

slides and/or segments were presented to them at approximately four-second intervals. The slides and/or audio segments were displayed at a constant and rapid pace to insure consistency and an appropriate level of stress in all four groups. After each two-minute time period, subjects were given a 15 second break. After one of the three intervals, a given group of subjects completed the State Trait Anxiety Test during a 45 second break.

To test subjects' decoding abilities and to insure that stress became a factor in the experiment, the subjects had to be given a rationale for the task asked of them and they had to become ego-involved. To enhance the experiment's validity, a bogus rationale was created so that the students would become ego-involved with the task and make judgments about the emotions to the best of their ability, thus creating a consistent level of stress across all four groups (critical to the success of creating high stress in the two experimental groups). At the beginning of the administration of the experiment, the researcher introduced herself as a staff member of the University of Arizona's Communication Department and related the following information:

> The Department of Communication would like to know the communication competence level of the students involved in the introductory level communication classes. The results of the test will be given to your individual instructors who will then give you your personal results. The result of the test will be kept confidential and will not be used in the assessment of your grade. The individual results will be compared with everyone in the present group and with everyone in your communication classes; therefore, please be aware that you are in a sense in competition with each other. If we are to give you an accurate

assessment of your communication aptitude, you should attempt to do your very best.

Before beginning the experiment, the subjects were told what to expect during the test, including whether or not the colors presented to them would be consistent or inconsistent. Subjects were debriefed immediately following the experiment and instructed not to discuss the experiment with anyone for a two-week period.

Manipulation Check

Stress levels were measured by two separate administrations of the State Trait Anxiety Test (STAI), a self-evaluation, stress questionnaire developed by Spielberger, Gorsuch, and Luchene (1968). This widely used and supported psychological test substantiated whether or not stress was created and maintained over time for all subjects. The baseline of subjects' levels of stress was determined by the first report of the STAI. The determination of a change and/or maintenance of stress was based on the second administration of the STAI. The second measurement of the STAI followed the first, second or third time period and was assigned randomly. The random assignment of the second STAI assessment following one of the three time periods was done to control for time as an intervening variable (e.g., the change in STAI due to the time of the administration of the test or change due to the overall amount of time needed to complete the experiment).

CHAPTER 3

RESULTS

Manipulation Check

An independent group t-test which examined the post test mean scores on the State Trait Anxiety Test between the two main groups of high stress and low stress indicated that there was a difference in stress levels experienced by the two groups. The high stress group was significantly more anxious and stressed than the low stress group, t (370) = 4.05, $p < .01$. The mean score for the high stress group was 2.30, while the mean score for the low stress group was 2.18 on a 4 point scale. Within each group, a paired t-test examined the levels of stress experienced before and during the experiment. The low stress group experienced a decline in arousal, t (189) = 2.06, $p < .05$. No significant difference was found for the high stress group t (181) = -.89, $p < .37$. The Stroop Color-Word Test appeared to have maintained the original level of stress or anxiety created by the new situation in the high stress group, but did not create an increase in the level of stress experienced by the subjects.

Hypotheses and Research Question

The investigator tested the four hypotheses and one research question with a 2X2X2 univariate analysis of variance. The dependent variable was decoding accuracy and the independent variables were the nonverbal channel (kinesic or vocalic), level of stress (high or low), and gender. Analyses examined the overall effects as well as within each time period (1st, 2nd and 3rd).

Hypothesis One

Hypothesis one examined whether an increase in stress caused an individual's nonverbal decoding capabilities to decrease in accuracy and was not supported. No significant main effect for stress and no interaction between stress and channel was found during the overall analysis.

A significant main effect for stress was found during time period three, F (1, 364) = 7.42, $p < .01$, = .01 which indicates that the effects of stress over time may have been becoming a factor in the accuracy of decoding (see Table 1, Appendix A).

Hypothesis Two

Hypothesis two examined whether the kinesic channel was more accurate for decoding nonverbal emotional cues than the vocalic channel and was significantly supported. As predicted, the subjects who used the kinesic channel consistently were more accurate at decoding emotions as portrayed during the overall

analysis, F (1, 364) = 130.32, $p < .01$, $^2 = .25$ (see Table 2, Appendix A). The means for the kinesic channel, high and low were 79.65 and 80.85, respectively, while the means for the vocalic channel, high and low were 67.54 and 69.53, respectively (see Table 3, Appendix A; Figure 1, Appendix B). The significant main effect for channel remained consistent across all three time periods such that subjects using the kinesic channel were consistently more accurate than subjects using the vocalic channel (see Figure 2, Appendix B). In order, the results of the analysis of variance for time period 1, 2 and 3 were: F (1, 364) = 239.17, $p < .01$, $^2 = .38$; F (1, 364) = 28.96, $p < .01$, $^2 = .07$; F (1, 364) = 4.83, $p < .05$, $^2 = .02$ (see Table 4, Appendix A). The means for each group (high stress kinesic, low stress kinesic, high stress vocalic, low stress vocalic) and each time period (time periods 1, 2, and 3) can be found in Table 3, Appendix A.

Hypothesis Three

Hypothesis three examined whether in a stressful situation there would be an ordinal interaction such that the vocalic channel would be significantly more debilitated by a high degree of stress during time period one and was supported. The analysis of each of the individual time periods indicated a significant ordinal, two-way interaction within time period one between stress and channel, F (1, 364) = 5.03, $p < .05$, $^2 = .01$, such that decoders using the kinesic channel were consistently more accurate

than decoders using the vocalic channel and decoders using the vocalic channel during low stress were significantly more accurate than vocalic decoders during the high stress condition (see Table 4, Appendix A). A Tukey post hoc comparison confirmed this relationship (see Table 4, Appendix A).

Hypothesis Four

Hypothesis four examined whether females showed greater accuracy in decoding emotions than males and was supported. The results showed that there was a significant overall main effect, F (1, 364) = 10.77, $p < .01$, ^{2} = .02 (see Table 3, Appendix A). The overall mean scores for males and females can be found in Table 5, Appendix A. Females were consistently found to be more accurate in all conditions in the overall analysis and within time periods one and two (see Figure 3, Appendix B). The main effect for gender for each time period (time periods 1 and 2), in order are: F (1, 364) = 11.78, $p < .01$, ^{2} = .02; F (1,364) = 8.40, $p < .01$, ^{2} = .02 (see Table 4, Appendix A). The means for each of the groups for time periods one and two are listed in Table 5, Appendix A.

Research Question

The research question asked if stress differentially affected males and females. The results showed that stress affected females and males in a similar manner (see Table 5, Appendix A; Figure 3, Appendix B). There was, however, one

qualification to this general affect of stress on females and males. Males decoding accuracy increased to a greater degree, than females decoding accuracy during time period three. Further, there was no significant main effect for gender during time period three and may be representative of an adaption to the stress by males.

CHAPTER 4

DISCUSSION

This experiment was undertaken to examine the impact stress has upon individuals' abilities to decode emotions through the two main nonverbal channels of the face and the voice and the role of gender in that process. The overall analysis did not support hypothesis one, an increase in stress did not cause an individual's nonverbal decoding capabilities to decrease in accuracy. Hypotheses two and three, which examined decoding accuracy differences between the kinesic and vocalic channels were supported. Consistent with past research females were found to be more accurate decoders in hypothesis four. In addition, the research question concerning the affects of stress on males and females suggests that males and females are similarly affected.

Hypothesis one which examined whether an increase in stress caused an individual's nonverbal decoding capabilities to decrease in accuracy, was not supported. Overall, stress did not significantly impact upon decoders' abilities to decode emotions. However, stress as an intervening variable can not be dismissed entirely due to the finding of an ordinal, two way interaction during time period one. It appears that the subjects during time period one attempted to cope rapidly with the stressful situation

created by the new task. This finding is consistent with Appley and Trumble's (1967) surmising that a rapid coping process is the natural reaction to stress. An examination of the patterns of accuracy scores for all four groups showed that the induced stress affected the kinesic and vocalic group differently. The induced stress appeared originally to orient the subjects' attention to the task in the high and low stress kinesic groups. These findings are supported by Welford's (1972) belief that stress brings out the best in individuals if their optimum tolerance level is reached. Welford also noted that performance quickly dissipates with the persistence of stress. During the first two minutes of the task, the induced stress must have touched upon the optimum tolerance level for subjects using the kinesic channel, while in the second two minutes, stress reached beyond the subjects' optimum levels, and was followed by the process of adaption during time period three.

The high stress vocalic group performing the exact same task within the same time constraints showed the opposite reaction however. The original two minutes of the experiment for the high stress vocalic group showed almost a complete breakdown in nonverbal sensitivity. Accuracy diminished to just above the fifty-percent mark. The low stress vocalic group performed markedly better than the high stress vocalic group, but was still significantly worse than either kinesic group. The results of the impact of stress on the vocalic group are comparable to Mandler's

(1979) findings that stress past the point of alerting, interferes with the efficiency of the cognitive processes. The differences in reaction between the kinesic and vocalic groups suggests that individuals using the vocalic channel have a more difficult time concentrating on specific cues during stress and are more easily distracted from the vocalic cues during stress. This finding should, however, only be accepted tentatively until further research substantiates it.

The decoding patterns displayed during time period two exhibited that there was a drastic decrease in accuracy for the kinesic channels (both high and low stress) and also a decrease in accuracy for the vocalic group with low stress. Decoding accuracy for the vocalic group with high stress increased during time period two but was still lower in accuracy than any of the other three groups. The increase in decoding accuracy for the high stress vocalic group may mean that the coping abilities of the individuals in that group were finally beginning to function.

Time period three revealed a marked improvement in decoding accuracy for the low stress kinesic group. They had the highest mean for decoding accuracy in that time period. The high stress kinesic group also improved their mean accuracy scores over those from time period two, but they remained lower than their time period one scores and the low stress kinesic groups' third period accuracy scores. The groups decoding emotions in the vocalic channel also showed improvement but were still lower in

accuracy than either kinesic channel. The increase in accuracy during time period three may have indicated that the task was no longer new and uncertain to the subjects; thus, there was a reduction of stress by the end of the experiment for the subjects. The final two minutes of the task may have best represented the subjects' adaption to stress over time (Cox, 1978). Fatigue becomes a major factor with stress over time and may be partially responsible for the significant main effect for stress found during the third time period (Welford, 1974). The absence of overall significant findings of an interaction between stress and channel or a main effect for stress may have been the result of a lack of a high degree of stress found in the high stress groups. This supposition will be more fully explored in the discussion concerning the manipulation check findings.

Hypothesis two examined the impact of the channel on accuracy during a stressful situation. The experimenter predicted the kinesic channel as the most accurate conduit for decoding cues. This hypothesis was strongly supported by the overall results and by the examination of the three individual time periods, which showed the effects of stress for each channel over time.

Subjects using the kinesic channels during high and low stress made consistently more accurate judgments of emotion than subjects using the vocalic channel. Findings that the face

provided more accurate information about emotional states are consistent with the previous literature examining accuracy (Buck 1980; DiMatteo & Hall, 1979; Mehrabian & Ferris, 1969: Bugental et al., 1970; DePaulo & Rosenthal; Ekman, et al., 1980; Leathers & Emigh, 1980; Leathers, 1986). A possible explanation for the superior accuracy found in the kinesic channel may be the difference in control of the decoding process. Berman et al. (1976) surmised that the facial decoder could quickly scan the face for information and then go back to the pertinent features for further examination, while the vocalic decoder could only accept the sounds as they came. A second possible explanation of the superior accuracy found in the kinesic channel is that the face gives more information to the decoders concerning the affective states of individuals (Buck, 1980; Berman, Shulman, & Morwit, 1976: Ekman, Friesen & Ancoli, 1980; Leathers & Emigh, 1980; Leathers, 1986). Three other explanations in support of the kinesic channel superiority are the greater preference for and confidence in judgments of facial expressions by decoders (DiMatteo & Hall, 1979) and that humans attend deliberately to the visual channel because it is not automatically alerting like audio cues (Posner, Nissen, & Klein, 1976).

A narrowing of the differences in accuracy between the kinesic channel and the vocalic channel by the third time period might signify that the strong impact of stress on the vocalic channel is initial and then dissipates. Therefore, over time,

individuals who rely on the vocalic channel for information adapt to stressful environments and become more efficient in the use of this channel. However, the increase in accuracy was still not large enough to compensate for the superiority of the facial, kinesic channel for giving information about individuals' emotional states.

Hypothesis three predicted an ordinal interaction such that the vocalic channel would be significantly more debilitated by high stress than the kinesic channel during time period one. This hypothesis was supported and reconfirmed through the use of a Tukey post hoc test. Due to the uncertainty and newness of the task, time period one was the most stressful time period for the subjects and was therefore of the greatest interest to this experiment. Subjects who used the kinesic channel during the high and low stress conditions initially became oriented to the task, while subjects who used the vocalic channel, especially those in the high stress condition showed almost a complete breakdown in nonverbal sensitivity. If the voice has a greater alerting capacity than the face, is most often used to alert the decoders attention, and is not as focused upon for information, then the ordinal interaction is the result of the stress pushing beyond the point of alerting in the vocalic, high stress condition and interferes with the efficiency of the cognitive process (Mandler, 1979).

Hypothesis four sought to examine whether the previous findings of female superiority in decoding abilities would remain consistent. The significant main effect found for gender during the overall evaluation and during time periods one and two substantiated the fact that gender is an important intervening variable when examining nonverbal sensitivity. Females consistently were more accurate in judging emotions overall when using the vocalic and the kinesic channels. This finding was consistent with previous literature citing the superior decoding abilities of females (Zuckerman et al., 1976: 1979b; 1975; Fugita et al., 1980; Buck et al., 1972).

The research question sought to examine whether stress differentially affected males and females. The main effect for gender during the overall evaluation and during time periods one and two suggested that males and females were affected in a similar manner by the two levels of stress (high and low). However, there was a qualification to this general trend. Time period three showed that differences in decoding accuracy due to gender during stress over time became almost insignificant. Males appeared to adapt more quickly to the stress and their mean accuracy scores for time period three improved dramatically. The results pose an interesting question about the interaction of stress, time, adaptability and gender, and merits closer examination.

The manipulation check substantiated the fact that there was a significant difference in the stress levels experienced by subjects in the high stress and low stress groups. The fact that different stress levels were created supported the premise that the two groups were different and that the difference in decoding scores could be attributed to the different levels of stress created in each group. Interestingly, the low stress group's level of stress was reduced during the experiment. The high stress group's level of stress was slightly but not significantly increased from their baseline level of stress taken prior to the commencement of the experiment. The incongruent version of the Stroop Color-Word Test used during the high stress conditions appeared to have maintained the original level of anxiety present at the beginning of the new and uncertain task. The inability to create a significant increase in stress for the high stress group may explain the overall lack of support for an interaction of stress and channel with decoding abilities and a main effect for stress. There are three possible explanations for the limited support and the minimal increase in the level of stress experienced by subjects in the high stress groups.

First of all, the Stroop Color-Word Test needed to be presented to the subjects at a fast and consistent rate. In order for the incongruency of color, written word, and audio to create stress, the words had to be "flashed" quickly (Jensen & Rowher, 1966; Thurstone & Mellinger, 1953). However, the subjects needed

enough time to posit and mark judgments about each slide. Furthermore, the emotional slides and vocalic recordings were intermixed with the Stroop slides, and enough time for each emotion to be decoded had to be allotted. Each subject in the experiment had identical amounts of time to make the necessary judgments. Therefore, a common, "optimal" amount of time for the experiment had to be established to fulfill all of the guidelines necessary to create the different levels of stress (high or low) within each group. It was vital to control for time (length of each time period and entire experiment) as an intervening variable, thus establishing that the stress created by the two versions of the Stroop Test and not time differences was responsible for any differences in accuracy found. While time was controlled for and the presentation of slides was pretested for the minimal amount of time necessary for the judgments, the Stroop slides should probably have been presented at a faster rate to create a higher level of stress.

Secondly, the transactional model of stress emphasized the importance of the subject believing there would be adverse consequences if they failed to meet the task (Cox, 1978; McGrath, 1970). A degree of ego-involvement was necessary in order for stress to be achieved. The subjects may not have believed that the task was a communication aptitude test. They may have also realized that the results of their "test" would not have any direct or dire effect on them. Future tests done in this manner

could remedy this problem by giving them a "grade" for the task or by offering a monetary reward to the person with the highest accuracy rate.

Finally, stress was measured only through the State Trait Anxiety Test, a self-evaluation measurement. Research has shown that self-evaluations are not the most effective or reliable method of measurement. Subjects are not always aware of their emotional states nor do they accurately report them, therefore, physiological measurements of stress may be more effective in future research of this kind. In addition, the STAI used a four-point scale to measure subjects' judgments. A five or seven-point scale may more effectively delineate differences in attitude about stress or anxiety.

Further Research

This study tested the effect of stress on the decoding process, a variable of import since how individuals receive and interpret information during stress could have a major impact on the communication process. But decoding is only half of the process. Research examining stress and its impact on the communication process should also examine its effect on individuals' encoding abilities.

This study examined only two channels of communication; if stress affects the facial, kinesic and vocalic channel, it might affect every channel used during communication and should be

explored in greater detail. In addition, people use more than one channel when communicating. Thus, channels used concurrently should also be examined to test whether the impact of stress would lead to greater confusion for the decoder due to the increased amount of information that would be present in the multiple channels or whether the information from the multiple channels would have a "building" effect upon each other and would increase the decoding accuracy.

Research should scrutinize the impact of "life stress" in addition to the situational stress created in an experimental laboratory. Scholars examining stress and its impact on communication need to bridge the span between the stimulus-congruency-overload type of stress that is created in the laboratory and the highly salient, overarching issue of stress in people's lives that is created through events such as a death in the family or a loss of a job. At this point, it is inappropriate and impossible to widely generalize about stress and communication from the stress created in the laboratory, but it is a starting point. To try to bridge the gap between laboratory created stress and "real life" stress, the following suggestions are posited. Psychological tests could be given to subjects to rate the level of stress in their lives, thus incorporating daily stress into the overall evaluation of stress levels during experiments. In addition, examining subjects during stressful periods of their lives such as during unemployment or utilizing subjects with

recognizably stressful jobs, such as police, nurses or air-traffic controllers, would take into account the stress levels experienced daily in our society as well as gain in generalizability.

Implications for Research on Stress and Communication

Research examining stress and its impact on the communication process has many implications for scholars in the communication field, as well as many other fields. Psychologists, counselors and communication specialists dealing with marriage and family relations need to understand that stress itself may be blocking effective communication. Scholars designing instructional media and studying mediated forms of communication need to understand how stress will impact on and alter their messages. Organizations need to be aware of how stress in their environment affects the communication of employees. Managers communicating to subordinates during periods of high stress would have to insure that messages were accurately and completely received. In short, stress is prevalent in our society, and it is not going to go away. It is necessary for us to learn more about how it is affecting a vital part of our lives—our communication.

APPENDIX A

STATISTICAL TABLES

The following tables compile the results of statistical analysis. Table 1 is the analysis of variance for each time period. Table 2 is the overall analysis of variance table. Table 3 portrays the means for channel and stress conditions for the overall time period, for each individual time period, and the summary of mean scores of decoding accuracy by condition and time. Table 4 represents the significant findings of the Tukey Post Hoc Test for the ordinal interaction found in time period one. Table 5 portrays the mean scores of decoding accuracy by gender for each condition and for each time period.

Table 1. Analysis of Variance for each Time Period

Analysis of Variance--Time Period 1

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	50186.69	3	16728.90	83.12	<.01
Stress	311.22	1	311.22	1.55	NS
Code	48137.46	1	48137.46	239.17	<.01
Gender	2370.20	1	2370.20	11.78	<.01
2-Way Interactions	1279.54	3	426.51	2.12	NS
Stress Code	1013.17	1	1013.17	5.03	<.05
Stress Gender	5.07	1	5.07	.02	NS
Code Gender	232.91	1	232.91	1.16	NS
3-Way Interactions	113.30	1	113.30	.56	NS
Stress Code Gender	113.30	1	113.30	.56	NS
Explained	51579.53	7	7368.50	36.61	<.01
Residual	73262.13	364	201.27		
Total	124841.67	371	336.50		

Table 1--Continued

Analysis of Variance--Time Period 2

Source of Variation	Sum of Squares	DF	Mean Square	F	
Main Effects	8884.17	3	2961.13	12.13	<.01
Stress	21.15	1	21.15	.09	NS
Code	7068.25	1	7068.25	28.96	<.01
Gender	2048.33	1	2048.33	8.39	<.01
2-Way Interactions	216.07	3	72.02	.29	NS
Stress Code	4.36	1	4.36	.02	NS
Stress Gender	137.27	1	137.27	.56	NS
Code Gender	72.90	1	79.90	.30	NS
3-Way Interactions	67.46	1	67.46	.27	NS
Stress Code Gender	67.46	1	67.46	.27	NS
Explained	9167.69	7	1309.67	5.36	<.01
Residual	88844.133	364	244.08		
Total	98011.83	371	264.18		

Table 1--Continued

Analysis of Variance--Time Period 3

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	2414.32	3	804.77	4.10	<.01
Stress	947.41	1	947.41	4.83	<.05
Code	1453.83	1	1453.41	7.42	<.01
Gender	18.18	1	18.18	.09	NS
2-Way Interactions	969.17	3	323.05	1.65	NS
Stress Code	727.53	1	727.53	3.71	NS
Stress Gender	118.48	1	118.48	.60	NS
Code Gender	157.08	1	157.08	.80	NS
3-Way Interactions	103.77	1	103.77	.53	NS
Stress Code Gender	103.77	1	103.77	.53	NS
Explained	3487.26	7	498.18	2.54	<.05
Residual	71357.91	364	196.04		
Total	74845.16	371	201.74		

Table 2. Analysis of Variance for Overall Summary

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects	14033.34	3	4677.78	47.02	<.01
Stress	213.38	1	213.38	2.14	NS
Code	12965.96	1	12965.96	130.32	<.01
Gender	1071.62	1	1071.62	10.77	<.01
2-Way Interactions	116.92	3	38.97	.40	NS
Stress Code	5.36	1	5.36	.05	NS
Stress Gender	68.63	1	68.63	.69	NS
Code Gender	41.20	1	41.20	.41	NS
3-Way Interactions	8.35	1	8.35	.08	NS
Stress Code Gender	8.35	1	8.35	.08	NS
Explained	14158.61	7	2022.66	20.33	<.01
Residual	36214.23	364	99.49		
Total	50372.85	371	135.78		

Table 3. Means for Channel and Stress Condition for the Overall Time Period and for each Individual Time Period

	Across All Time Periods		
	Kinesic	Vocalic	Overall
High	79.65	67.54	73.59
Low	80.85	69.53	75.19
Overall	80.25	68.53	74.39
	Time Period 1		
	Kinesic	Vocalic	Overall
High	85.85	59.66	72.75
Low	84.39	65.22	74.80
Overall	85.12	62.44	73.77
	Time Period 2		
	Kinesic	Vocalic	Overall
High	73.51	64.55	69.03
Low	72.76	64.57	68.66
Overall	73.13	64.56	68.84
	Time Period 3		
	Kinesic	Vocalic	Overall
High	79.57	78.41	78.99
Low	85.41	78.80	82.10
Overall	82.49	78.60	80.55

Table 3—Continued

Summary of Mean Scores of Decoding Accuracy by Condition and Time

Condition	Overall	Time Period T1	T2	T3
High Stress Kinesic	79.65	85.85	73.51	79.57
High Stress Vocalic	67.54	59.66	64.55	78.41
Low Stress Kinesic	80.85	84.39	72.76	85.41
Low Stress Vocalic	69.53	65.22	64.57	78.80
Kinesic Overall	80.85	85.12	73.13	82.49
Vocalic Overall	68.53	62.44	64.56	78.60
High Stress Overall	73.59	72.75	69.03	78.99
Low Stress Overall	75.19	74.80	68.66	82.10

Table 4. Tukey Comparison of Means for Time Period One

		Channel	
		Kinesic	Vocalic
Stress	High	85.85a (94)	59.66c (88)
Level	Low	84.39a (98)	65.22b (92)

Note: Means with different letters are significantly different from each other.

Table 5. Means for Gender and Stress Condition for the Overall Time Period and for each Individual Time Period

	Across all Time Periods		
	Males	Females	Overall
High	72.29	74.84	73.56
Low	72.91	76.16	74.53
Overall	72.60	75.50	74.05
	Time Period 1		
	Males	Females	Overall
High	70.29	75.10	72.69
Low	72.02	77.21	74.61
Overall	71.15	76.15	73.65
	Time Period 2		
	Males	Females	Overall
High	67.26	70.71	68.98
Low	65.61	71.44	68.52
Overall	66.43	71.07	68.75
	Time Period 3		
	Males	Females	Overall
High	79.30	78.69	78.99
Low	81.10	82.84	81.97
Overall	80.20	80.76	80.48

Table 5—Continued

Summary of Mean Scores of Decoding Accuracy by Condition and Time

Condition	Overall	Time Period T1	T2	T3
High Stress Overall	73.56	72.69	68.98	78.99
High Stress Males	72.29	70.29	67.26	79.30
High Stress Females	74.84	75.10	70.71	78.69
Low Stress Overall	74.53	74.61	68.52	81.97
Low Stress Males	72.91	72.02	65.61	81.10
Low Stress Females	76.16	77.21	71.44	82.84
Males Overall	72.60	71.15	66.43	80.20
Females Overall	75.50	76.15	71.07	80.76

APPENDIX B

FIGURES

The following figures demonstrate the results of the statistical analysis. Figure 1 portrays the decoding accuracy by stress and channel. Figure 2 illustrates the differences in accuracy between the high and low stress conditions combined. Figure 3 shows the gender differences in decoding accuracy by level of stress and by channel.

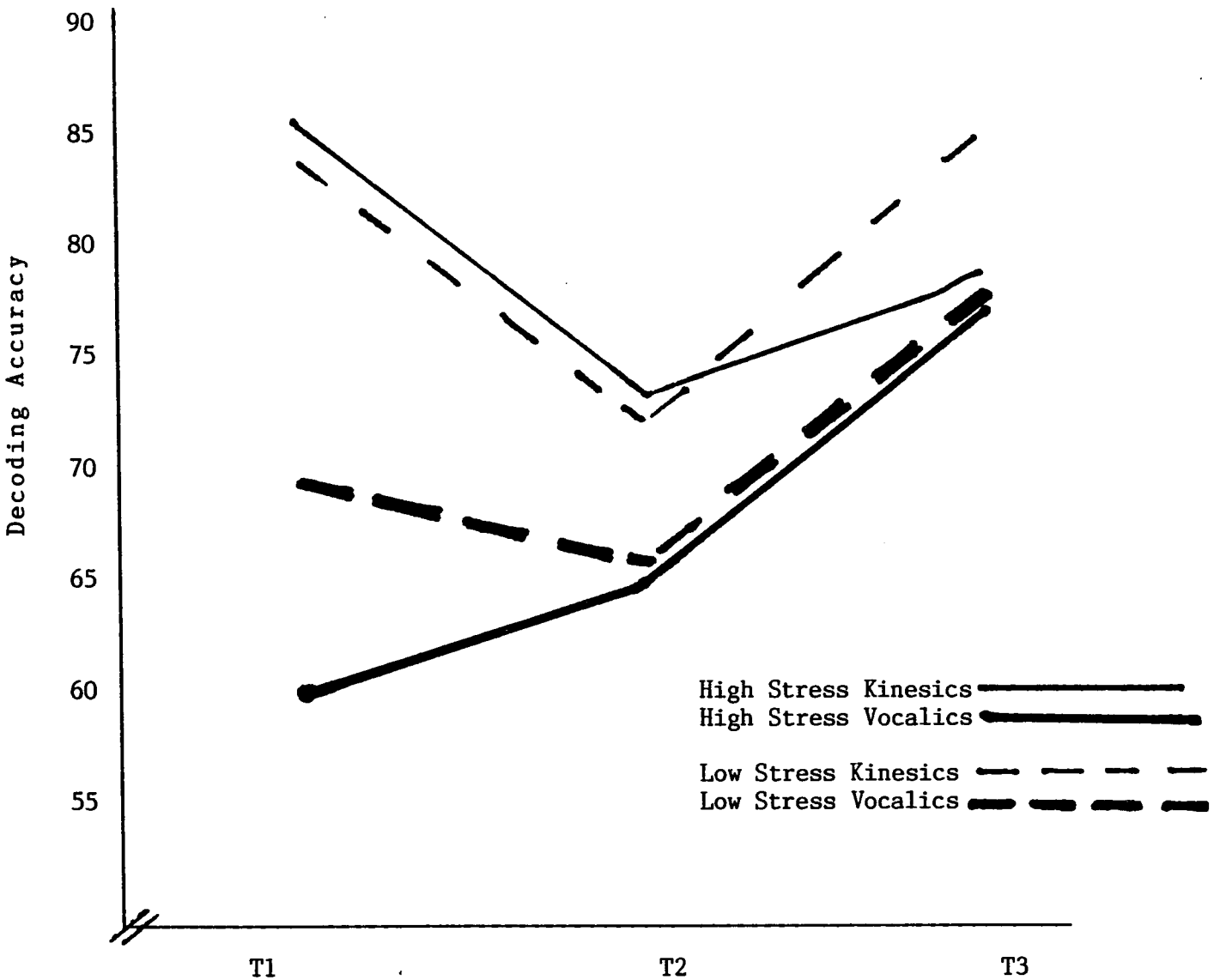

Figure 1. Decoding Accuracy by Stress and Channel

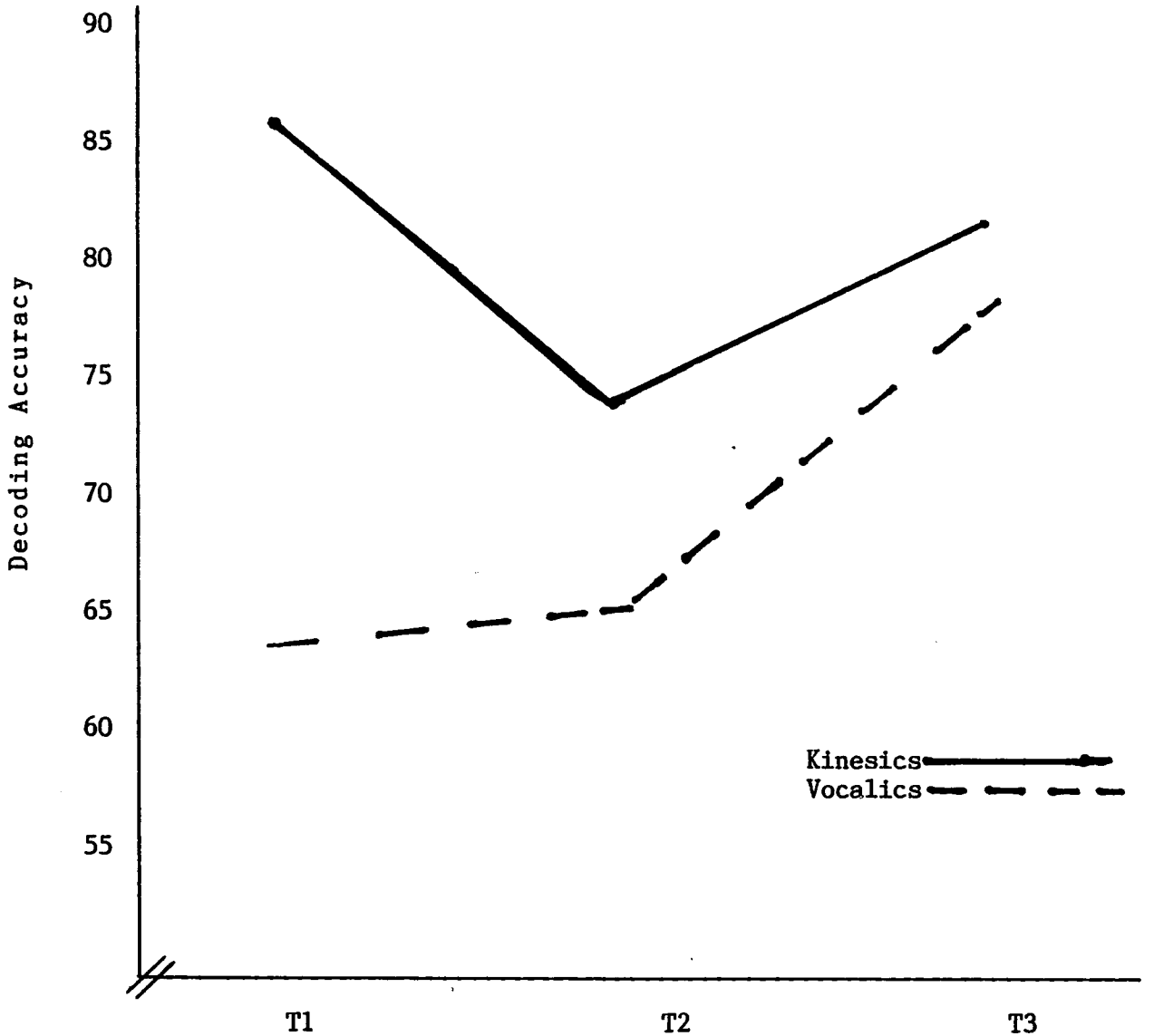

Figure 2. High and Low Stress Conditions Combined

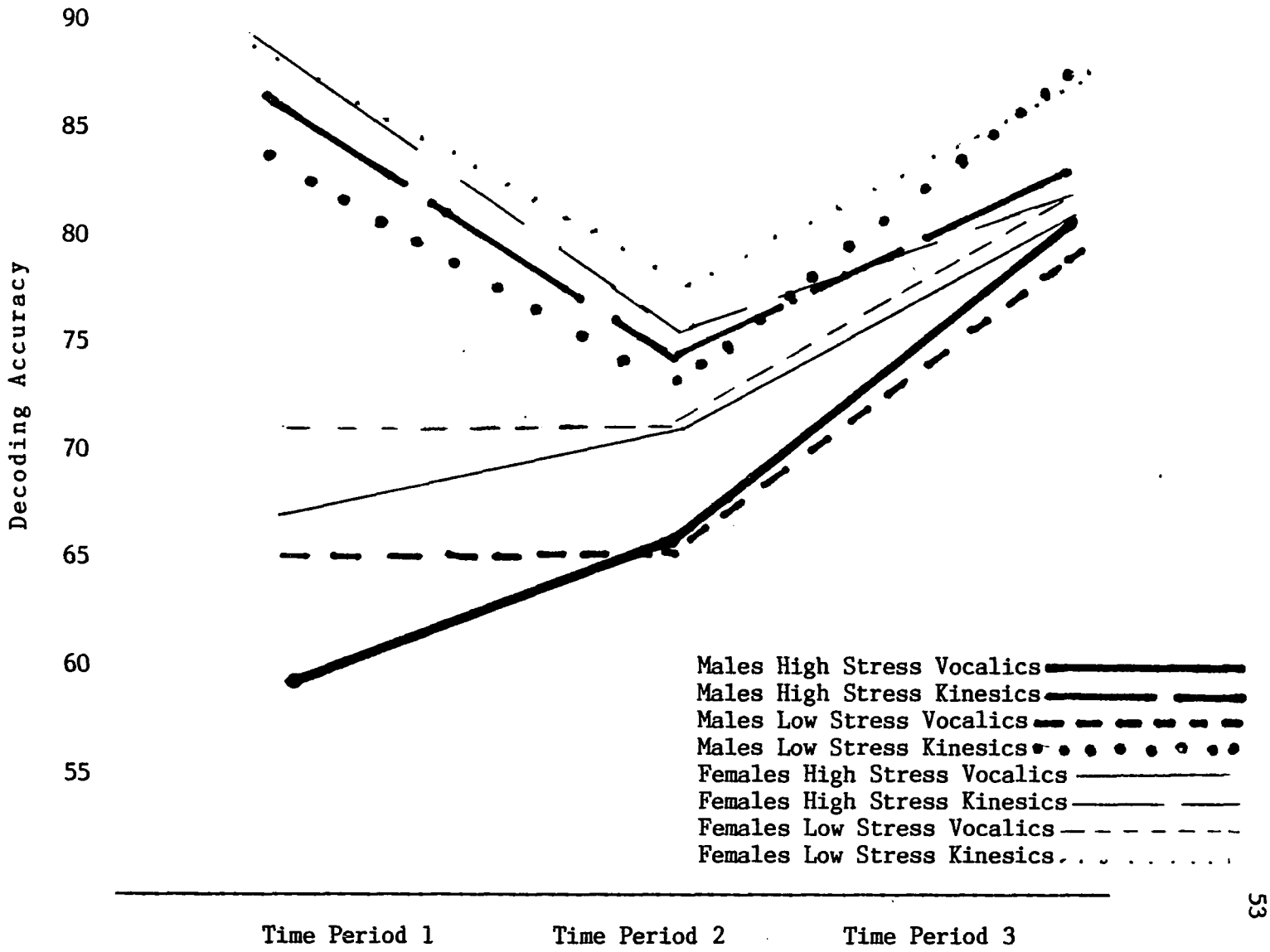

Figure 3. Gender Differences Over Time

APPENDIX C

QUESTIONNAIRES

The following questionnaires were used to collect data for this experiment. Form 1 was used to gather demographic information. Form 2 was the State Trait Anxiety Test (STAI) used to measure the subject's level of stress. Forms 3 - 5 labeled the Communication Aptitude Test was the form used to record the subjects judgments of emotion and color for each of the three time periods.

COMMUNICATION APTITUDE TEST

In order to give you the results of your test please answer the following questions.

1. What is your matriculation number? _____

2. What is your class and section number? _____

3. What is your gender? _____ Male (1) _____ Female (2)

4. What is your age? _____ Years

5. What is your rank in school?

   Freshman (1) ___ Sophomore (2) ___

   Junior (3) ___ Senior (4) ___

   Continuing Education (5) ___

6. What is your racial background?

   Anglo (1) ___ Black (2) ___ Hispanic (3) ___

   Asiatic (4) ___ Other (5) (please specify) ___

Thank you very much for your cooperation.

SELF-EVALUATION QUESTIONNAIRE

Developed by C. D. Spielberger, R. L. Gorsuch and R. Lushene

STAI FORM X-1

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then mark an "X" on the appropriate number (1 = not at all, 2 = somewhat, 3 = moderately so, 4 = very much so) to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings. Give your immediate response or reaction to the question.

1.	I feel calm	1	2	3	4
2.	I am frustrated	1	2	3	4
3.	I am tense	1	2	3	4
4.	I feel at ease	1	2	3	4
5.	I feel upset	1	2	3	4
6.	I feel rested	1	2	3	4
7.	I feel anxious	1	2	3	4
8.	I feel comfortable	1	2	3	4
9.	I feel self-confident	1	2	3	4
10.	I feel nervous	1	2	3	4
11.	I am jittery	1	2	3	4
12.	I feel "high strung"	1	2	3	4
13.	I am relaxed	1	2	3	4
14.	I feel content	1	2	3	4
15.	I am worried	1	2	3	4
16.	I feel over-excited and "rattled"	1	2	3	4
17.	I feel no stress	1	2	3	4
18.	I feel pleasant	1	2	3	4
19.	I feel "stressed out"	1	2	3	4
20.	I feel secure	1	2	3	4

COMMUNICATION APTITUDE TEST: TIME PERIOD 1

Please circle the appropriate color or emotion (only one choice per line). You must make a decision for every color slide and for every emotion (facial expression or vocalic expression).

1	green	black	red	blue	yellow	purple	1
2	green	black	red	blue	yellow	purple	2
3	green	black	red	blue	yellow	purple	3
4	green	black	red	blue	yellow	purple	4
5	green	black	red	blue	yellow	purple	5
6	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	6
7	green	black	red	blue	yellow	purple	7
8	green	black	red	blue	yellow	purple	8
9	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	9
10	green	black	red	blue	yellow	purple	10
11	green	black	red	blue	yellow	purple	11
12	green	black	red	blue	yellow	purple	12
13	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	13
14	green	black	red	blue	yellow	purple	14
15	green	black	red	blue	yellow	purple	15
16	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	16
17	green	black	red	blue	yellow	purple	17
18	green	black	red	blue	yellow	purple	18
19	green	black	red	blue	yellow	purple	19
20	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	20
21	green	black	red	blue	yellow	purple	21
22	green	black	red	blue	yellow	purple	22
23	green	black	red	blue	yellow	purple	23
24	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	24
25	green	black	red	blue	yellow	purple	25
26	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	26
27	green	black	red	blue	yellow	purple	27
28	green	black	red	blue	yellow	purple	28
29	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	29
30	green	black	red	blue	yellow	purple	30
31	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	31
32	green	black	red	blue	yellow	purple	32
33	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	33
34	green	black	red	blue	yellow	purple	34
35	green	black	red	blue	yellow	purple	35
36	green	black	red	blue	yellow	purple	36

COMMUNICATION APTITUDE TEST: TIME PERIOD 2

Please circle the appropriate color or emotion (only one choice per line). You must make a decision for every color slide and for every emotion (facial expression or vocalic expression).

1	green	black	red	blue	yellow	purple	1
2	green	black	red	blue	yellow	purple	2
3	green	black	red	blue	yellow	purple	3
4	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	4
5	green	black	red	blue	yellow	purple	5
6	green	black	red	blue	yellow	purple	6
7	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	7
8	green	black	red	blue	yellow	purple	8
9	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	9
10	green	black	red	blue	yellow	purple	10
11	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	11
12	green	black	red	blue	yellow	purple	12
13	green	black	red	blue	yellow	purple	13
14	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	14
15	green	black	red	blue	yellow	purple	15
16	green	black	red	blue	yellow	purple	16
17	green	black	red	blue	yellow	purple	17
18	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	18
19	green	black	red	blue	yellow	purple	19
20	green	black	red	blue	yellow	purple	20
21	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	21
22	green	black	red	blue	yellow	purple	22
23	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	23
24	green	black	red	blue	yellow	purple	24
25	green	black	red	blue	yellow	purple	25
26	green	black	red	blue	yellow	purple	26
27	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	27
28	green	black	red	blue	yellow	purple	28
29	green	black	red	blue	yellow	purple	29
30	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	30
31	green	black	red	blue	yellow	purple	31
32	green	black	red	blue	yellow	purple	32
33	green	black	red	blue	yellow	purple	33
34	green	black	red	blue	yellow	purple	34
35	green	black	red	blue	yellow	purple	35

COMMUNICATION APTITUDE TEST - TIME PERIOD 3

Please circle the appropriate color or emotion (only one choice per line). You must make a decision for every color slide and for every emotion (facial expression or vocalic expression).

1	green	black	red	blue	yellow	purple	1
2	green	black	red	blue	yellow	purple	2
3	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	3
4	green	black	red	blue	yellow	purple	4
5	green	black	red	blue	yellow	purple	5
6	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	6
7	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	7
8	green	black	red	blue	yellow	purple	8
9	green	black	red	blue	yellow	purple	9
10	green	black	red	blue	yellow	purple	10
11	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	11
12	green	black	red	blue	yellow	purple	12
13	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	13
14	green	black	red	blue	yellow	purple	14
15	green	black	red	blue	yellow	purple	15
16	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	16
17	green	black	red	blue	yellow	purple	17
18	green	black	red	blue	yellow	purple	18
19	green	black	red	blue	yellow	purple	19
20	green	black	red	blue	yellow	purple	20
21	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	21
22	green	black	red	blue	yellow	purple	22
23	green	black	red	blue	yellow	purple	23
24	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	24
25	green	black	red	blue	yellow	purple	25
26	green	black	red	blue	yellow	purple	26
27	green	black	red	blue	yellow	purple	27
28	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	28
29	green	black	red	blue	yellow	purple	29
30	green	black	red	blue	yellow	purple	30
31	green	black	red	blue	yellow	purple	31
32	ANGER	HAPPY	SAD	FEAR	SURPRISE	DISGUST	32
33	green	black	red	blue	yellow	purple	33
34	green	black	red	blue	yellow	purple	34
35	green	black	red	blue	yellow	purple	35
36	green	black	red	blue	yellow	purple	36

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