TEMPORAL AND AFFECT PROPERTIES

OF SCHEMATIC FIGURES

By

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Bachelor of Arts

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Edmond, Oklahoma

1967

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
August, 1969

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ACKNOWLEDGEMENTS

I would like to express my appreciation to those persons whose assistance made this research possible.

I especially wish to acknowledge Dr. Robert Weber, who as thesis chairman gave much of his time towards the planning and preparation of this research. I would also like to thank Drs. Kenneth Sandvold, William Rambo, and Donald Schweitzer for their helpful suggestions and criticism. In addition, I wish to give special thanks to my husband, Steve, for his constant support and encouragement. Finally, I wish to express my sincere appreciation to my parents for all of their assistance towards the completion of this research.

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Facial expression and its relationship to social perception has been a prevalent topic of study throughout the years. A large amount of research has been done regarding judgmental scaling operations for facial features. To date, however, few attempts have been made to obtain a time measure for such scaling operations. Reaction time measures have been obtained for simple responses and choice responses to stimuli such as words and letters. Rarely have reaction time measures been taken for recognition or naming of facial expressions. Thus, a time measure as well as a scale value might be beneficial to further distinguish between degrees of facial expressions of emotion.

The purpose of the present study is to obtain a choice reaction time measure for recognition of faces versus non-faces and relate it to one of several types of scaling operations. Differentiation will also be made between part and whole faces. Subjects will be divided on the basis of scaling operation to which they are assigned. The scaling operation will be designated by the instructional set given the subject. An attempt will also be made to relate the reaction time measure to one of the processes underlying choice reaction time. The distinction among choice reaction time theories lies in whether a Template or a Feature Testing theory is operating and whether the search process is serial or parallel. A further explanation of these terms will be given in a later section.

Most of the research in the area of facial expression has been based on three major theories of emotion. These theories are those of Darwin (1872), James-Lange (1884), and Wundt (1896). All three of these theories proved influential for subsequent research, but Wundt made the major contribution as to the number of dimensions of feeling. Wundt (1896) broke with the existing tradition of a single dimension of Pleasure-Pain for all emotions. He proposed three dimensions of feeling: Pleasantness-Unpleasantness, Excitement-Quiet, and Tension-Relaxation. These three dimensions were later to become most important in the scaling of facial expressions.

Review of the Literature on Facial Expression

Abstract Facial Models

Based on the above theories of emotion, a number of persons began building models representative of the various facial expressions.

Piderit (1867) based one of the earliest attempts at model building on mimickery and physiognomy, called geometry of expression. Using a series of plaster head models, Piderit was the first to do detailed research of facial expressions. Based on the results of Piderit's work, a fairly uniform naming of expressions to a designated series of pictures was obtained.

A slightly more sophisticated attempt at model building was that of Boring and Titchener (1923). These men developed a profile model, adapted directly from Piderit's model with only slight modifications. The advantage of Boring and Titchener's model over Piderit's was that the various components (eyes, mouths, noses, and eyebrows) could be separately interchanged on one model. Boring and Titchener provided meanings for each of the possible composite faces, which they used primarily for demonstrational purposes. Other authors have since used these faces and meanings for research purposes.

Guilford and Wilke (1930) made the next major attempt at model building. They employed a full face model with all pieces interchangeable. It was similar to a puzzle with the pieces fitting together, rather than a life size demonstrational form, having only certain interchangeable pieces. Again, Guilford and Wilke's model was used mostly for demonstrational purposes.

A further attempt to improve upon existing facial models was undertaken by White and Landis (1930). These authors attempted to introduce moveable parts on silhouettes and relate their emotive value to perceptual processes and socialization.

All of the above models have been concerned with relatively abstract representations of facial expression. Though used widely for demonstrational purposes, few of these models were utilized to any great extent in the study of emotive content in facial expression. After an extensive review of the literature, the only study found to be similar to the present in terms of stimulus material used was that of Irwin (1932). Using circular faces, having either straight-line or curved components, he made an attempt to study the relationship of thresholds for perception of differences in various expressions. Irwin states that due to the number of subjects used, only five, and the diversity of judgements of these subjects, no relevant results were obtained.

Photographic Facial Models

Current emphasis has centered upon the use of posed facial expressions as portrayed in photographs. One of the earliest of the posed models was that of Ruckmick (1921). Ruckmick used a posed actress to depict the expressions of: sorrow, mirth, scorn, anger, fear, joy, anguish, apprehension, and suspense. His finding that the mouth is the single most significant feature of facial expression has been supported by several other researchers (Dunlap, 1927; Wundt, 1896). Thus Ruckmick was one of the earliest to make the distinction between whole and part components of facial expression.

The model most often cited in contemporary literature was developed by Frois-Wittmann (1930). This model has become the standard for most of the work in the area of facial expression. The Frois-Wittmann series consists of a series of 227 expressions of a posed actor. Each face has a designated name for the expression portrayed, based on modal frequencies of from 15 to 143 judgements per picture. Frois-Wittmann unlike Ruckmick, concluded that the part components are relative to the rest of the pattern, with no one part always the dominant one. Hullin and Katz (1935) lend support to the concept that subject's judgment of the various expressions of the Frois-Wittmann pictures agrees with the assigned name. This was an initial step towards standardization of the Frois-Wittmann pictures. Drawings as well as photographs were utilized by Frois-Wittmann for initial standardization processes and as a comparison of whole versus part components. As will be shown later, this comparison of whole versus part components for schematic figures (i.e., drawings) is included as a portion of the present study. In most studies comparing whole versus part components the stimuli have been photographic models. Drawings were not retained as a part of the Frois-Wittmann series of facial expressions. Photographs were later substituted for these drawings. The reason for such a substitution is never clearly stated.

The Lightfoot Picture Series (Engen, Levy, & Schlosberg, 1957) is a less widely used but more current series of facial expressions than the Frois-Wittmann (1930) Series. The Lightfoot series consists of a group of 48 photographs of a posed actress.

Scales of Facial Dimension

One major scale of facial dimensions is Woodworth's (1938) scale which he based on earlier data obtained by Feleky (1914). Woodworth's scale consists of 6 dimensions: 1-Love, Happiness, Mirth; 2-Surprise; 3-Fear, Suffering; 4-Anger, Determination; 5-Disgust; 6-Contempt.

Employing the Frois-Wittmann pictures, Schlosberg (1941) devised two scales, Attention-Rejection and Pleasant-Unpleasant to account for the basic dimensions of facial variation. Schlosberg later (1954) added a third dimension of facial variation, Sleep-Tension. Schlosberg's three dimensions are almost identical to those proposed by Wundt in 1896. Schlosberg's scales have been found to be good predictors of values in other widely used scales (i.e., Engen & Levy, 1956; Engen, Levy, & Schlosberg, 1958; Levy & Schlosberg, 1960).

In comparing the scales of Schlosberg and Woodworth, Schlosberg (1952) has shown that Woodworth's spread of judgments for all 6 dimensions form a circular series having less distinction for extreme and neutral emotions than Schlosberg's scale due to all of the axes being of the same length. In addition, Schlosberg's (1941) scale for the Pleasant-Unpleasant distinction yields a wider range of judgments than Woodworth's equivalent dimension appearing on this scale. Thus, Schlosberg's scale is more adaptable to both extreme expressions and neutral expressions than Woodworth's scale.

Though not as widely used as Schlosberg's dimensions, Osgood and Suci's Semantic Differential Method (1957) was used by Kauranne (1964) to study variables of facial expression in the Frois-Wittmann pictures. Using a five point scale to measure such dimensions as Good-Bad, Weak-Strong, and Beautiful-Ugly, Kauranne obtained results similar to Schlosberg (1952) and Nummenmaa and Kauranne (1958). Three major factors corresponding to Schlosberg's Pleasant, Unpleasant, and Rejection dimensions were found to exist. No correspondence was found for Attention, the other dimension of one of Schlosberg's scales (i.e., Attention-Rejection). The Sleep-Tension dimension was not considered. A different method of studying facial expression in terms of Osgood and Suci's Semantic Differential Scale was employed by Williams and Sundene (1965). These authors attempted to compare judged emotionality for visual (photographs) versus vocally presented (taped recordings) stimuli. Matches between recordings and photos were previously determined by a panel of judges. Their findings indicate that recognition of emotional states may be similar for visual, vocal, or combined visual-vocal mode of stimulus presentation. Certain restrictions were placed on this possible similarity. For example, extreme expressions in photographs and corresponding taped statements considered to be close enough matches were the only ones retained in the actual experiment (i.e., social control dimension). Similarity does seem to exist between visual and vocal modes on dimensions of general evaluation and activity.

Thus the major scales for judgment of facial expression are those of Schlosberg (1941, 1954), Woodworth (1938), and Osgood and Suci (1957), although numerous other scales are also in use. No agreement has been reached as to one best scale for judging facial expression. The optimum length of a scale for judgment of facial expressions is also much in doubt (Guilford, 1954).

Both favorable and unfavorable comments have been cited concerning the use of facial photographs and abstract facial models. Criticism of the use of involuntary expressions in photographs has been voiced by the major proponents in this area.

Frois-Wittmann (1930) states,

> Although the use of composite photographs is possible, one can overlook certain distortions better in drawings, and interchangeable drawings are easier to produce. Even with their peculiar limitations they have advantages over photographs, e.g., a greater clarity of outline, sometimes blurred in the photographs, and the elimination of the foreshortening which together create, in the individually presented features of the photographs, an illusion of tilting of the head, thus giving a clue to the expression of the whole face. ...But the drawing ought to be a good substitute, i.e., be detailed enough to resemble a photograph as much as possible (p. 118).

Thus his view places emphasis somewhere between the use of photographs and abstract drawings.

Schlosberg (1954) suggests that much work needs to be done in the area of facial expressions. He states that the width of the range of Frois-Wittmann pictures used may have been too restrictive, since the pictures employed to represent emotions were posed and not voluntary. Photographs do have the advantage of being more life-like, regardless of whether voluntary or involuntary expressions are presented. They also offer a wider range of expressions than abstract faces, which is helpful for judgmental scaling procedures. However, abstract faces also offer certain advantages. They afford greater simplicity of expression and more clearly defined dimensions than photographs of faces. Due to the simplicity of design, abstract faces may produce shorter reaction times than more complex facial expressions, and be equally as adaptable to simple scaling procedures. Finally, abstract facial expressions are not concerned with the problem of whether voluntary and involuntary expressions of emotion are the same.

Reaction Time

Attention Value

Since the present study employs, primarily, a reaction time measure it is now appropriate to consider a separate class of literature. Reaction time studies relating to recognition, estimation of attention value, and emotion in visual or vocal modes have utilized words, letters, or figures other than faces as the stimulus mode.

The study most closely related to the present study in terms of measuring attention value as well as obtaining a measure of reaction time is that of Bokander (1962). Bokander used two stimulus pictures one noted for involvement value (I), a woman bent over a corpse, and one neutral (N) picture, cars parked on an empty street. Longer simple reaction times were found to be statistically significant for the involvement stimulus than for the neutral stimulus. The same results were found using a TAT picture with an ugly, threatening stimulus as the I stimulus, and the same TAT picture with a smiling face as the N stimulus. The threatening, involvement stimulus and neutral smiling stimulus in the periphery of the same TAT card were adopted from the work of Kraugh (1962).

A major study which has stimulated much research in the area of attention value is that of Guilford and Ewart (1940). They used magazine advertisements as distractor stimuli and measured the increase in reaction time to a buzzer with picture as opposed to a buzzer alone.

Reaction time during distraction was considered a measure of attention value, and decrease in reaction time with increasing exposure to be due to lowered attention. Colored versus uncolored stimuli were also compared, but this variable was found to be of no significance. Average reaction times were found to be longer with advertisements added than for buzzer alone.

Utilizing pictorial stimuli (magazine photographs) and verbal stimuli (familiar words), Lehr, Bergum, and Standing (1966) obtained measures of reaction time to scaling each stimulus on an Attractive-Unattractive dimension. As found in earlier studies by Bergum and Lehr (1966a, 1966b), when the subject is able to control looking time, attractive stimuli are evaluated more rapidly than unattractive or neutral stimuli. Random ordering of stimuli yield shorter reaction times and more positive affect than stimuli in either increasing or decreasing order of affect. Lehr, Bergum, and Standing (1966) hypothesize that "...the subject's set for attractive stimuli is more clearly defined than their set for unattractive stimuli, thus resulting in a more rapid evaluative decision for attractive items" (p. 1116).

The type of stimulus material to be identified seems to play a major role in reaction time measures. Fraisse (1960), using reaction time to the words square, hexagon, triangle, and octagon, and the corresponding figures, found reaction time for naming a word was shorter than for naming a shape. A comparison of naming various stimulus modes, familiar faces, animals, colors, symbols, and letters, yielded a much smaller mean error rate for letters than other stimuli (Morin, Konick, Troxell,& McPherson, 1965). These results were attributed to a greater amount of overlearning for letters as opposed to the other stimuli.

These authors, in agreement with Fraisse, concluded that, "...over-learning is not a sufficient condition to produce independence of reaction time and number of stimulus alternatives" (Morin, Konick, Troxell and McPherson, 1965, p. 314).

The choice of descriptive terms to describe any given shape often presents a problem because some shapes have a wider range of descriptive terms which may be applicable (Morin, Konick, Troxell, and McPherson, 1965).

> Reading, more than most other real life situations, encourages reliance on fragmentary features as opposed to full indentification. Hence, it is not surprising that Morin, et. al., 1965 found evidence for parallel processing only with letters. (Neisser, 1967, p. 101).

Letters, unlike the other stimuli used by Morin et. al. 1965, have only one association which is usually made rather than a number of possible alternatives from which to choose. It is possible that using face or non-face as the stimulus dimensions and requiring a simple choice response may also supply evidence in favor of parallel processing.

An earlier study (Morin and Forrin, 1965) explored the hypothesis that the effects of stimulus uncertainty decrease with the strength of S-R associations until they approach zero, i.e., reaction time per item is constant irrespective of number of alternatives. Findings indicated a significant linear function of reaction time against number of stimulus alternatives exists for arbitrary S-R associations, but that reaction time to highly learned associations (like visual letters and letter names) is not increased by increasing the size of the stimulus set. Other researchers have found different effects based on the number of alternatives and amount of practice. Varying the number of alternatives was found to have a negligible effect on reaction time by Mowbray and Rhoades (1959), and Neisser, Novick, and Lazar (1963).

Similarly, Morin and Forrin (1965) found no relation between set and reaction time. However, Nickerson (1966) found an increase in reaction time with a corresponding increase in number of alternatives.

None of the studies attempting to relate attention or involvement value to reaction time uses emotional content of the figure or pattern as its measure of attention value. It is in this area that the present study seeks to provide some preliminary evidence.

Instructional Set

It is now appropriate to consider several studies relating instructions and reaction time since an experimental manipulation in this study employs instructional set in terms of requiring different subsequent scaling operations for the same stimuli.

The relationship of reaction time to naming or some type of identifying response seems to rely on the instructional set given the subject. Worell and Worell (1963) compared standard reaction time instructions emphasizing speed to instructions having no reference to speed. Their findings indicate an increase in speed of simple reaction time when instructions place emphasis on speed rather than on accuracy. In a related study, Kushner (1963), failed to find significant differences between standard, success, and failure conditions for instructional sub-groups. Standard instructions emphasized speed; success instructions informed Ss of success on a prior task; and failure instructions informed Ss of failure on a prior task.

The relationship of instructions to choice reaction time has been stated by Fitts (1966). When instructional emphasis is on speed, mean reaction time decreases but error rate increases, and when instructional emphasis is on accuracy, the inverse of this relationship occurs.

Choice Reaction Time

The task employed in the present study is essentially one of choice reaction time. The area of choice reaction time seems, at present, to be dominated by two opposing theories, those of Sternberg and Neisser versus those of Hick and Nickerson.

The major differentiation of theories of choice reaction time is on the basis of the processes involved in stimulus categorization, i.e., Template Matching versus Feature Testing. Template models assume a matching of stimulus information with information stored in memory on the basis of the total pattern; whereas, Feature Testing models assume this matching process is on the basis of individual features or parts of the figure or pattern.

The basic issue within Template Theories concerns the type of matching process which occurs in a choice situation. Sternberg argues in favor of a sequential or serial stimulus categorization process, while Neisser argues for a parallel comparison of stimuli. This dichotomy has also been studied by Egeth (1966). Portions of his findings comparing reaction time for same-different judgments supported both serial and parallel search processes. The end result of the matching process may be exhaustive search, where all possible comparisons between stimulus dimensions are made before a decision is reached (Sternberg, 1967), or self-terminating, where comparisons continue only until a match of dimensions is made (Neisser, 1967).

Neither the Template nor the Feature Testing Model as yet seems capable of coping with practice effects on choice reaction time. The choice of model employed seems to be based on type of stimuli and number of alternatives. The possibility exists that a combination of the two models, one to account for early training and the other to account for later stages of training, might be feasible (Smith, 1968).

Pattern Perception

A means of coordinating the areas of facial expression and reaction time may lie in the area of pattern perception. One area of agreement among choice reaction time theories is that a series of cognitive sub-processes are involved. These processes, though called by different names, are all concerned with essentially the same operations. For instance, Welford (1960) said the operations entailed perceptual, translation, and effector mechanisms. Morin and Forrin (1963) discussed translation processes involving many:1 and 1:many comparisons. The first of the 2 terms, many or 1, refers to the number of stimuli presented, and the second term refers to the number of possible responses. Neisser (1967) postulates two processes at work in perception. The first process is the preattentive mechanism, which keeps a separate unit distinct from the rest of the pattern. This corresponds to what Neisser terms a primary process of thought. The second process he terms a focal attentive mechanism, such that the whole precedes the sum of the parts. In other words, one constructs an appropriate visual object from a general schema by filling in parts. In this secondary process the objects made available from the primary process are further developed, and attention is either deliberately focused upon sub-features or deliberately focused away from any object. Association of certain S-R patterns occurs only through prior pattern recognition (i.e., memory traces).

Neisser (1967) also states that an individual uses figural synthesis. This implies that he experiences familiarity to the extent that the present act is identical to an earlier one. Those attributes of a figure that are fully synthesized and named first are more likely to be correctly reported. Span of apprehension is limited to what can be synthesized and verbally stored. The over-all rate of this perceptual and translation process has been assumed to be that of the slower, translation process (Crossman, 1955).

Figural synthesis will be shown to have a definite relationship to the comparisons between faces and non-faces in the present study. If figural and emotional recognition are both preceded by synthesis, reaction time to respond to faces ought to be longer than the corresponding reaction time for non-faces. This follows because figural (line) features are at least as complex for faces as for non-faces. In addition, if emotionality is also recognized by synthesis the following statement should be true. If faces involve emotionality and non-faces do not, reaction time to faces ought to be much slower than to non-faces.

Thus, perception of figures follows some type of cognitive matching process, either of total pattern or component parts. Neither theory is as yet superior to the other. Both Template and Feature Testing Models have related number of alternative targets to reaction time. This relationship between reaction time and number of alternatives is termed Merkel's principle. It does seem to hold for stimuli such as faces and colors, but not for letters, words, or numerals (Hick, 1952; Hyman, 1953; Leonard, 1961; Morin, Konick, Troxell, and McPherson, 1965; Sternberg, 1967). This relationship, if not the major one, has had some bearing on most of the studies relating the areas of reaction time and pattern perception.

Speed of Reaction Time

Attempts have been made to try to explain speed of reaction time, mainly on the basis of order. Hyman (1953) related reduction in average reaction time to anticipation of a recognizable sequence of stimuli. Similarly, Hick (1952) related reduction in reaction time to number of errors. The inclusion of the concept of expectation as a factor shortening reaction time was first noted by Hyman (1953). He suggested that reaction time might be affected by order of inspection of dimensions, which can be partly determined before the signal arrives (i.e., which choice to try first).

Though still in the formative stages, work in the area of pattern perception may hold the key to the relationship between the areas of reaction time and facial expression. The proposed study attempts to examine such a relationship.

Facial expression research has contributed much towards the development of scales to measure emotive content in facial expressions. Reaction time research has led to the development of theories underlying man's visual search process. Reaction time and visual search processes have previously been primarily related to perception of words and letters. It now seems appropriate to investigate how man's visual search process is related to perception of emotive content in the face. Since the face is one of the most familiar of the stimuli with which one comes in contact in everyday experience, it should be of much interest to attempt to discover the processes underlying perception of the face. Reaction time offers one possible means of studying such a relationship.

CHAPTER II

STATEMENT OF THE PROBLEM

In all of the studies cited above, very little effort has been expended to study the interrelationships between the areas of facial expression, as judged from abstract faces or photographs, and reaction time for such a process. Previous studies have been concerned with correctness of judgments of facial expression or reaction times to other patterns of stimuli. Studies attempting to measure the affect value of facial expression have been concerned with correct identification of facial expression with one word, usually an adjective. The proposed study attempts to relate emotive value in facial patterns to reaction time. Pattern perception has been studied for the most part in terms of stimuli other than faces. Faces, however, are one of the most familiar of all stimulus patterns and should be a stimulus of much interest in terms of pattern perception. Reaction time offers a means of studying the search process involved in recognition and matching of perceptual patterns.

A major hypothesis is that a relationship exists between the complexity of scaling operation used and choice reaction time. Specifically, it is that reaction time increases with number of alternatives on the scale. This hypothesis then relates to the influence of instructions and number of response alternatives to reaction time.

Essentially, the variable of instructions, here designated in terms of type of scale to be used, is being manipulated to see its effect, if any, on reaction time.

Instructional set emphasizing speed has been found to increase the speed of reaction time (Fitts, 1966; Worell and Worell, 1963). Some researchers have found an increase in reaction time with a greater number of stimulus alternatives for certain stimuli (Morin & Forrin, 1965; Nickerson, 1966) while other researchers have found a negligible effect on reaction time by increasing the number of stimulus alternatives (Mowbray and Rhoades, 1959; Neisser, Novick, and Lazar, 1963). Varying the number of stimulus or response alternatives is essentially varying the degree of complexity of the task. The present study attempts to place emphasis on speed and vary the complexity of the task for various Ss in terms of the scaling operation to be performed, designated in the instructional set. By varying the degree of complexity of the task to be performed, as stated in the instructions given prior to any reaction time measure, the effect of the complexity of the task should be shown in the Ss speed of reaction time.

A second hypothesis concerns the distinction between the face and non-face stimuli. This hypothesis is that faces will have longer reaction times because they have emotive as well as figural properties.

A third question of interest concerns reaction time to various combinations of part and whole stimuli. In particular, it is hypothesized that part components ought to show shorter reaction times than whole faces because they usually have fewer dimensions. This would be predicted by a Feature Analysis theory.

CHAPTER III

METHOD

Subjects

A total of 70 subjects were volunteers from Introductory Psychology classes at Oklahoma State University. A total of 45 males and 25 females were used in the experiment. Though most of the studies of facial expression cited used both male and female subjects, only Levy and Schlosberg (1960) make any mention of sex differences. This difference was slight and related to Ss naming in agreement with assigned name.

Each of the 70 subjects was randomly assigned to one of 5 conditions. A total of 14 subjects per condition were used. All subjects viewed each of 21 different slides, consisting of one face (F) or nonface (N) per slide. Slides were initially arranged in the orders designated A and B. They were repeated four times in a counter-balanced order (i.e., ABBA).

Apparatus

An Anscochrome projector equipped with a Wollensak shutter was used to project each of 21 different slides. A switch, wired to a Hunter timer and power source, activated the shutter. A second lever, wired to the timer, stopped the timer when a response was made. A series of 84 slides of 21 different schematic figures, faces and nonfaces, were used. Faces consisted of circles with either straight or curved line components for eyes and mouths. Non-faces consisted of portions of these faces, blanks, or jumbled parts (see Figure 1).

Procedure

Each slide was shown for a fixed interval of one second. The figures were presented in the following arbitrary order to guard against expectancy:

A = N N F F N N N F N N F N F N N F F F N F N

B = F N N N F N F N N F N N F F F N N F N N F

Subjects were initially instructed to perform the choice reaction time response as quickly as possible, then to scale the figures on one of the designated scales. The scale used depended on the condition to which the subject was assigned. All subjects were shown drawings, as in Figure 1, on a sheet of white paper during the reading of the instructions.

Instructions were as follows:

> You will be shown a series of figures, some are like faces, such as this group here [pointing] and some are non-faces, such as this group here [pointing] [see Figure 1]. If the figure shown is a face, you are to respond with an upward (downward) lever press. If the figure shown is a non-face, you are to respond with a downward (upward) lever press. Leave the lever in the position you choose until this light reappears [pointing] or you hear a slight click, then return the lever to middle position. Respond as quickly as possible to each slide as it appears. Once you have made a response, don't try to change it. Remember, don't move the lever back to the middle position too quickly. After you have pressed the lever, a new figure will appear in a few moments. When the next figure appears, respond in the same way.

One half of the <u>S</u>s were instructed to make an upward lever press for face and a downward lever press for non-face. The other half of the <u>S</u>s were instructed to make a downward lever press for face and an upward lever press for non-face. This variation was employed to see if subjects consistently respond more quickly to one direction of lever press irrespective of the type of stimulus presented.

Immediately following this portion of the instructions, Ss received one of five sets of instructions depending upon the condition to which they were assigned. The conditions were based on the type of scaling procedure used. Conditions were designated as either five (F) or three (T) point depending on the numerical length of the scale. An additional name was attached to those scales having both positive and negative values, polarity, (P). The control group (C) responded only to the reaction time portion of the task and did not perform subsequent scaling of the figures. Conditions were as follows: F, five point scale consisting of the numbers 0,1,2,3,4, which Ss assigned on the basis of increasing emotional content in the figure; T, three point scale consisting of the numbers 0,1,2, which Ss assigned on the basis of increasing emotional content; FP, five point scale consisting of the numbers -2,-1,0,+1,+2, which Ss assigned on the basis of negative, neutral, or positive emotional content of varying degree; TP, three point scale consisting of the numbers -1,0,+1, which Ss assigned on the basis of negative, neutral, or positive emotional content; and C, control group. The respective instructions were as follows:

Condition F:

> After the completion of this task, the series of figures will reappear. This time I want you to give the figure a rating, a number from 0 to 4 which you think best describes the amount of emotional content expressed in each figure [S given scale]. Zero represents no emotional content and four represents the most emotional content. For example, the non-faces would probably receive a rating of zero or close to zero, the most emotional faces a rating of four or close to four, and the other faces a rating somewhere inbetween, either 1,2, or 3. You are to use all of the numbers,

0,1,2,3, & 4, but respond with only one number for each figure. I will give you this scale back when it is time for this portion of the task. I will say ready before each figure appears. Now, just respond as quickly as you can to each figure as it appears.

Condition T:

After the completion of this task, the series of figures will reappear. This time I want you to assign one of the numbers 0,1, or 2 to the figure you have just seen. Zero represents no emotion, 1 represents some degree of emotion, and 2 represents a slightly greater amount of emotion. Use all numbers at some time, but assign only one number to each figure, the number you think best describes the amount of emotional content in the figure. I will give you this scale back when it is time for this portion of the task. I will say ready before each figure appears. Now, just respond as quickly as you can to each figure as it appears.

Condition FP:

After the completion of this task, the series of figures will reappear. This time I want you to rate the figure on whether you think that the emotion represented is negative, neutral, or positive. If the figure has no emotion, rate it as neutral, or zero. If the figure has a large amount of negative emotion give it a -2. If it has a large amount of positive emotion give it a +2. If the figure has a lesser amount of emotion give it either a -1 or +1 depending on whether the emotion is negative or positive. Use all the numbers at some time, but respond with only one number for each figure, the one number which you think best describes the emotion portrayed by the figure. I will give you this scale back when it is time for this portion of the task. I will say ready before each figure appears. Now, just respond as quickly as you can to each figure as it appears.

Condition TP:

After the completion of this task, the series of figures will reappear. This time I want you to assign either a +1,-1, or 0 to each figure depending on the amount of emotional content represented by the figure. A +1 represents positive emotion, a -1 represents negative emotion, and a 0 represents no emotion. For example, a non-face would probably receive a rating of zero and faces either a +1,-1, or 0 depending on the emotion represented. Use all numbers at some time, but assign only one number to each figure. I will give you this scale back when it is time for this portion of the task. I will say ready before each figure appears. Now, just respond as quickly as you can to each figure as it appears.

Condition C:

These Ss received no further instructions.

The signal "ready" for each group was immediately followed by the experimenter releasing the slide for viewing. All subjects responded as quickly as possible to each of 84 slides. Reaction time in milliseconds and errors were recorded for each response. Following the reaction time portion of the task, each of the 21 different figures were shown an additional time for conditions F, T, FP, and TP. The order of presentation of the figures for the scaling portion of the task was A for 25 Ss and B for 31 Ss.

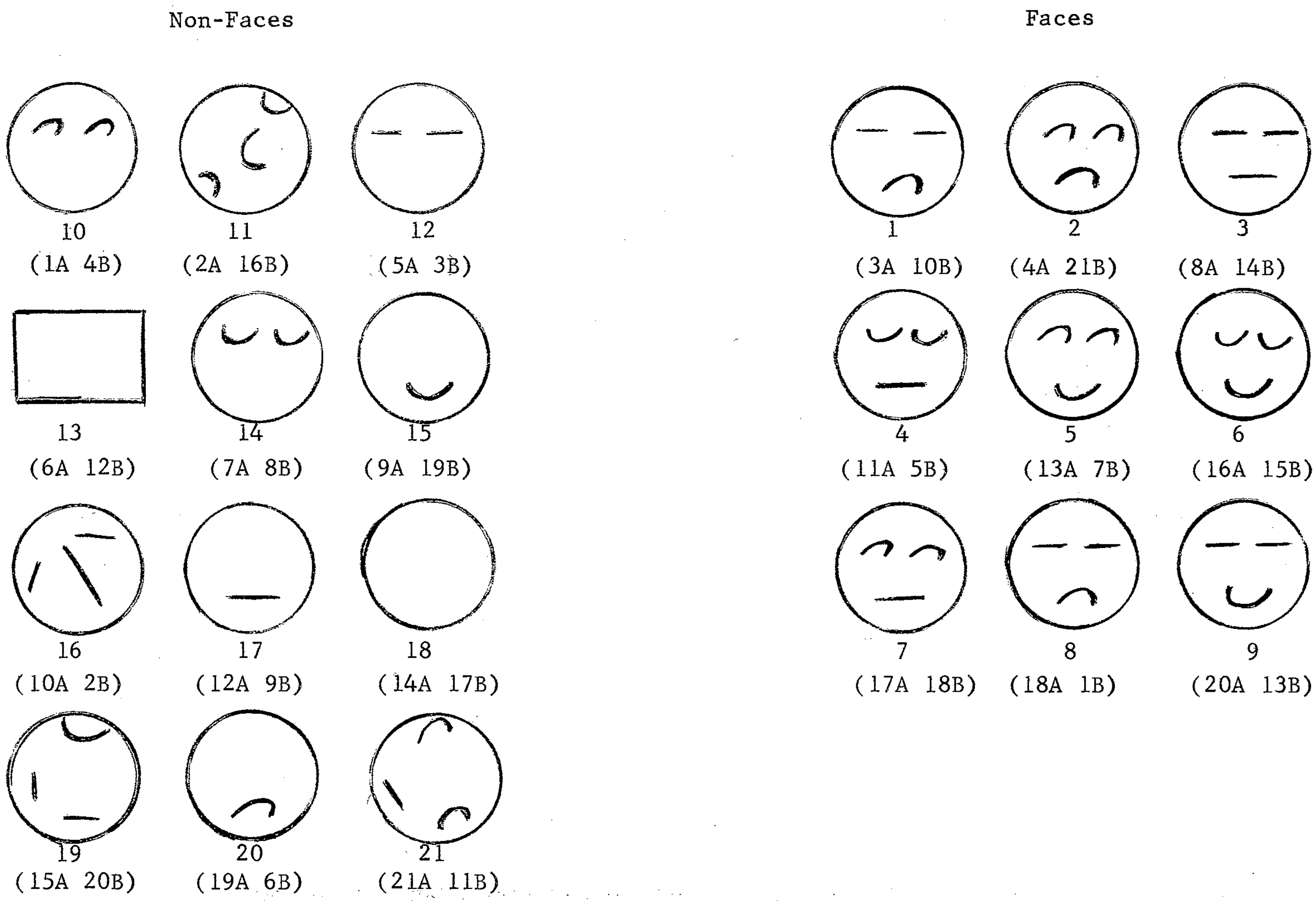

Figure 1. Schematic Figure Stimuli Used in All Conditions

CHAPTER IV

RESULTS

An analysis of variance for repeated measures was used to analyze the three factors of interest in this study. These factors were as follows: 1) Instructional Condition (F, T, FP, TP, C); 2) Direction of Response (up or down); and 3) Stimulus Material (face or non-face). This yields a 5 X 2 X 2 design. The first and second factors were between Ss and the third factor was within Ss. Cell entries were each S's mean reaction time over the 4 trials. (In some cases a S's mean reaction time was based on fewer than 4 trials, since only correct choice times were used. This exclusion was appropriate because reaction time distributions may very for correct choices and errors.)

From the analysis of variance shown in Table II it can be seen that only stimulus material is significant, F (1, 60) = 115.17, p < 001. However, this difference was not in the predicted direction. The hypothesis stated that reaction time to faces should be longer than to non-faces. The reverse was found, reaction time to faces was shorter than to non-faces under all conditions (See Figures 2 and 3). This is shown in summary form in Table I. Mean reaction time to faces was shorter than to non-faces under all conditions. In a similar manner, a much smaller percentage of errors was found to exist for faces than for non-faces under all conditions. The mean reaction times to each figure for responses in error may be found in Table III. As can be

TABLE I

MEAN REACTION TIMES (SECS.) AS A FUNCTION OF CONDITION

Statistic	Instructional Condition									
	C		F		T		FP		TP	
	F	NF	F	NF	F	NF	F	NF	F	NF
M	.59	.66	.55	.60	.61	.68	.53	.59	.54	.60
SD	.09	.16	.10	.11	.11	.13	.10	.06	.11	.14
Mean percentage errors	2.7	4.3	3.0	6.5	3.3	4.6	3.3	6.2	3.3	5.4

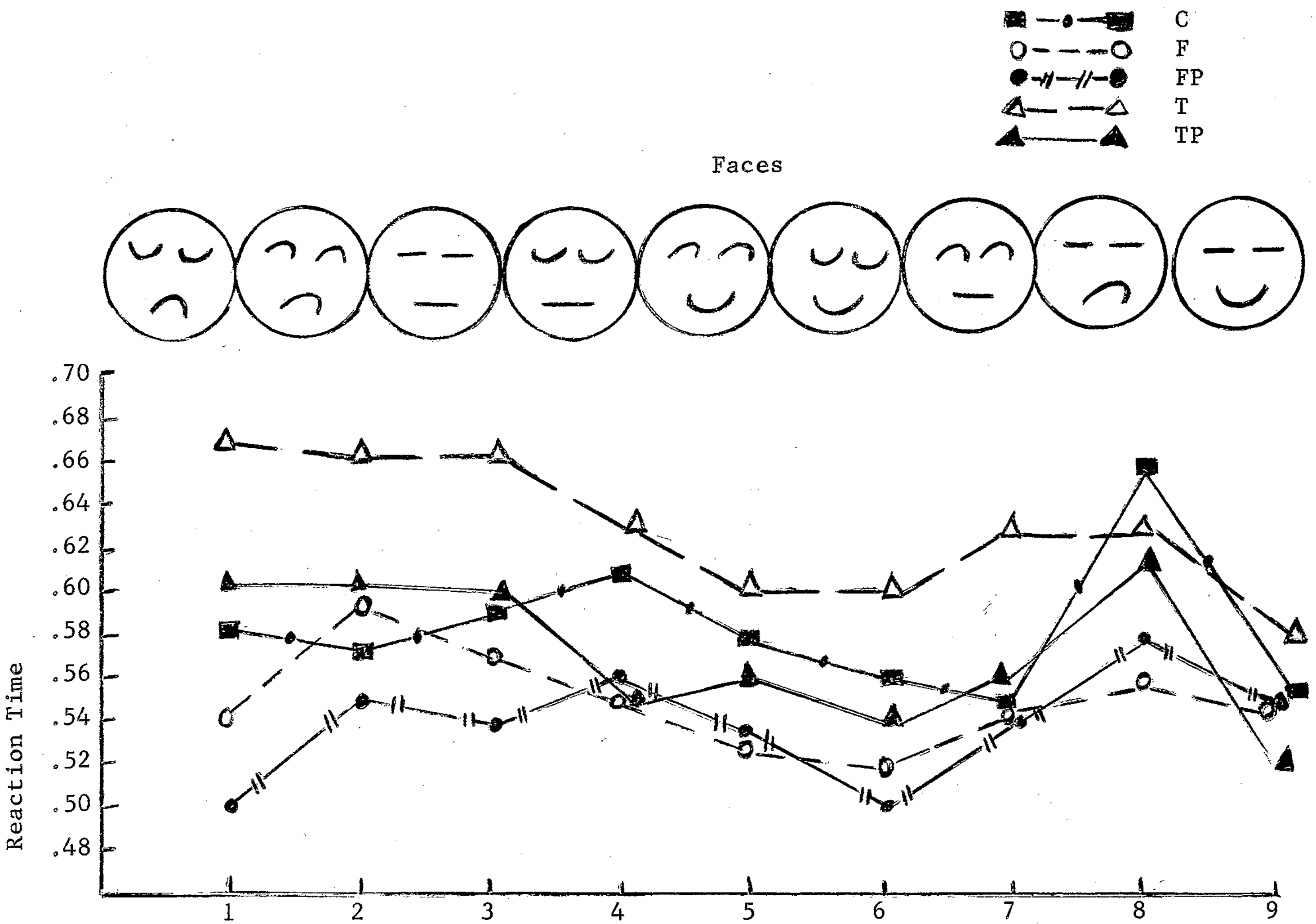

Figure 2. Response Time as a Function of Conditions and Stimulus Forms (Faces).

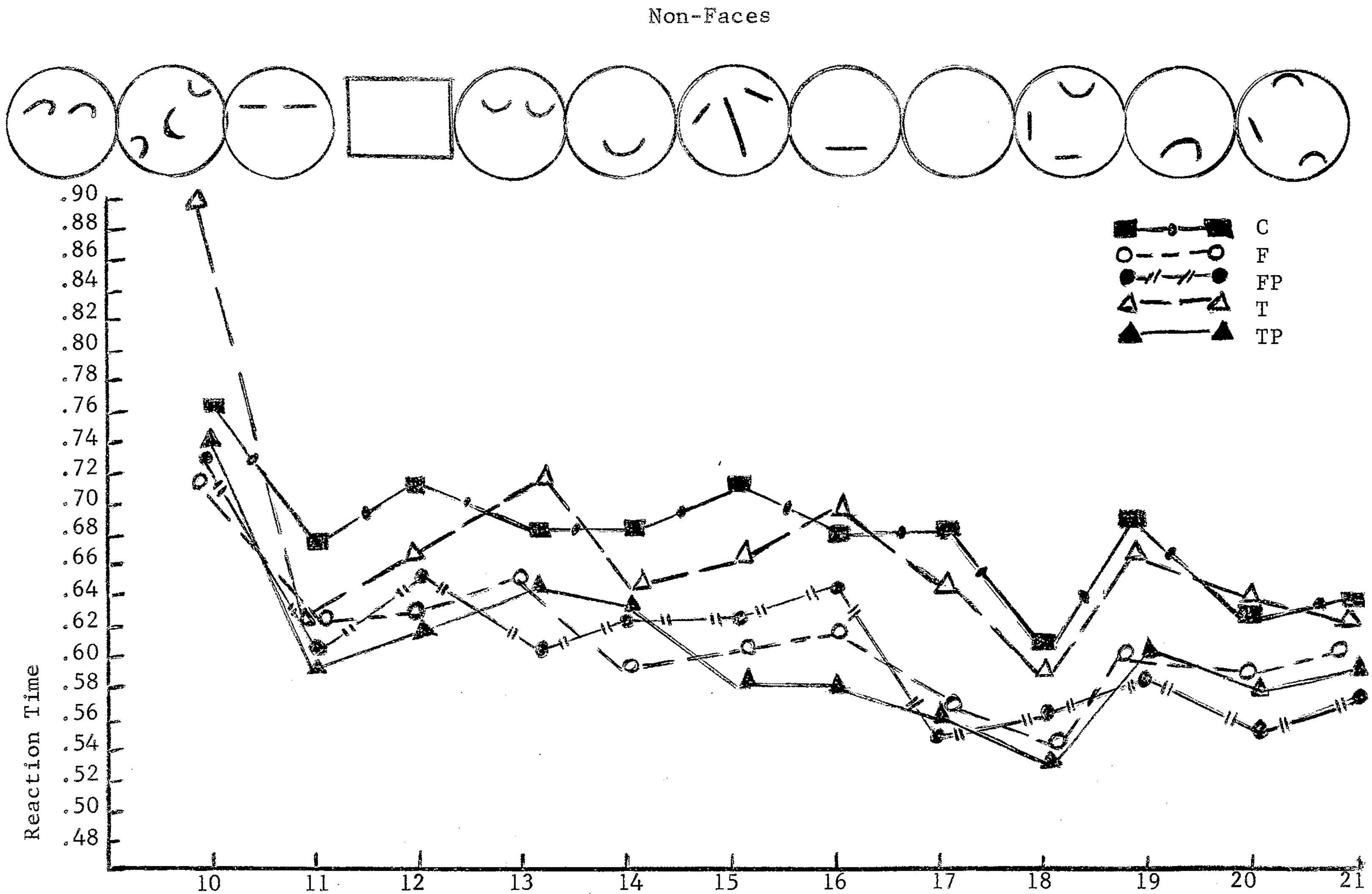

Figure 3. Response Time as a Function of Conditions and Stimulus Forms (Non-Faces).

TABLE II

ANALYSIS OF VARIANCE FOR THE THREE EXPERIMENTAL FACTORS

Source	df	MS	F	P
Between Ss	69			
Instructional Condition (C)	4	.0370	2.27	> .05
Response (R) (up vs. down)	1	.0275	1.69	> .05
C X R	4	.0073	.45	> .05
Ss w/in groups	60	.0163		
Within Ss	70			
Stimuli (S) (face vs. non-face)	1	.1382	115.17	.001
C X S	4	.0006	.5	> .05
R X S	1	0	-	-
C X R X S	4	.0012	1.00	> .05
S X Ss w/in groups	60	.0012		

TABLE III

MEAN REACTION TIMES FOR RESPONSES IN ERROR BY CONDITION AND FIGURE

	Instructional Condition									
	F		T		FP		TP		C	
Fig.	RT	Er.	RT	Er.	RT	Er.	RT	Er.	RT	Er.
1	.62	4	.46	5	.46	4	-	0	.58	3
2	.44	3	.61	4	.76	1	.70	4	.85	2
3	.47	8	-	0	.48	4	.49	2	.46	3
4	.39	2	.70	4	-	0	-	0	.83	1
5	.45	2	.54	3	.54	1	.58	1	.63	2
6	.48	2	-	0	.39	1	.47	1	.31	1
7	-	0	.35	1	.46	5	.73	1	.47	3
8	.65	4	.70	3	.57	3	.63	3	.48	4
9	.50	2	1.08	1	.47	2	-	0	.59	1
10	.67	6	.93	7	.88	8	.82	4	1.32	4
11	.34	1	-	0	.85	3	.56	5	.77	3
12	.84	3	.67	3	.87	3	.56	3	1.25	2
13	.67	3	.83	2	.76	1	.68	3	-	0
14	.53	5	.78	5	.76	6	.56	4	1.60	2
15	.86	3	.34	1	.43	2	.81	1	.58	3
16	-	0	.68	5	.42	3	.53	4	.78	3
17	.62	3	.47	1	.58	3	.58	1	-	0
18	-	0	.91	1	-	0	-	0	1.09	1
19	.40	2	.51	2	.55	3	.54	5	.86	5
20	.77	4	.74	3	.65	2	.63	3	.48	4
21	.74	4	.84	1	.68	2	.58	4	.89	1

seen, the blank circle produced the fewest responses in error, 2, across all conditions. Non-face number 1 produced the most responses in error, 29, across all conditions. Mean reaction times for responses having errors ranged from .31 to 1.60. The shortest reaction time, .31, was to a face, and the longest reaction time, 1.60, was to a non-face.

The hypothesis that reaction time increases with number of response alternatives (i.e., scale complexity) was not supported by the analysis of variance nor was the hypothesis that reaction time to component parts would be shorter than to whole faces. The mean reaction time to the two component parts comprising each face, for all possible combinations, was longer than for the corresponding whole face.

Thus, only the stimulus material factor, face versus non-face, was significant. This was the within-subject's factor which was the major contributing source of variation.

A more detailed breakdown of response time by stimulus form is shown in Figures 2 and 3 for faces and non-faces, respectively. In these figures mean response times are plotted against stimulus material by condition. All mean response times lie within the range .48 to .90. A further breakdown is that of mean reaction times to faces versus the corresponding reaction time to the component parts of each face. This is shown in summary form in Table IV. As can be seen from this table, all mean reaction times to component parts (eyes and mouths) are longer than mean reaction times to the corresponding faces. Since the mean reaction time for the component parts does not equal the mean reaction time for the corresponding face, these results do not support the principal of additivity.

TABLE IV

MEAN REACTION TIMES TO FACES VERSUS COMPONENT PARTS

	Face		Eyes + Mouth
1	.573	<	.613
2	.591	<	.681
3	.587	<	.623
4	.575	<	.611
5	.553	<	.702
6	.532	<	.633
7	.553	<	.679
8	.602	<	.625
9	.535	<	.646

Mean scale values to individual faces and non-faces may be found in Table V. As shown in this table, highest absolute mean scale values for all conditions were obtained for faces 5, 6, 8, and 9. Lowest absolute mean scale values were obtained for faces 2, 3, 4, 7 and 8. All of those faces receiving highest mean scale values contained curved-line mouth components. Three of the four faces receiving lowest mean scale values contain straight-line mouth components. Highest absolute mean scale values were obtained for non-faces 14, 16, 19, and 21. Lowest mean scale values were obtained for non-faces 11, 12, 15, 17, 18 and 20. Three of the four non-faces receiving highest mean scale values were jumbled faces. No consistent pattern of a single type of non-face was found to exist for lowest mean scale values to non-faces.

TABLE V

MEAN SCALE VALUES AS A FUNCTION OF INSTRUCTIONAL CONDITION AND SCHEMATIC FIGURES

	Faces					Non-Faces			
	F	FP	T	TP		F	FP	T	91
1	1.71	-.36	.64	-.29	10	1.71	-.43	1.00	-.29
2	1.79	-.21	.93	-.07	11	.14	-.50	.29	-.07
3	1.43	+.50	.57	+.36	12	1.50	+.21	1.14	+.07
4	1.43	+.14	.43	-.07	13	.64	-.43	.50	-.29
5	3.64	+1.29	1.79	+1.00	14	2.64	+.93	1.50	+.64
6	2.00	+1.36	.64	+.36	15	.71	0	.57	+.14
7	1.36	+.43	.50	+.43	16	1.57	-1.21	1.21	-.50
8	2.71	-.21	1.57	-.07	17	.14	-.14	.07	-.07
9	1.79	+1.36	.64	+.36	18	1.07	+.21	.50	0
					19	1.79	+.71	1.36	+.50
					20	1.14	-.07	.57	0
					21	1.71	-1.36	1.43	-.50

CHAPTER V

DISCUSSION

The findings of the present study seem to indicate that of the three factors under investigation, only stimulus material was found to have a significant effect on reaction time. This finding does not imply, however, that the other two factors, especially instructional condition, have no effect on speed of reaction time. There are several possible reasons for conditions and direction of response not showing significance.

Scale complexity as designated by instructional condition may not have contributed as a major source of variation due to the length of time intervening between instructions regarding the scaling task and the actual performance of that task. By requiring responses to all 84 stimuli before beginning the scaling task the effect of different instructions may have dissipated.

Future research might focus upon the differential effect of instructional set. A suggestion for such research which might show the possible differential effects of varied instructional sets would be to immediately follow the reaction time measure to each display form with the requisite scaling operation, designated by the condition to which the subject was assigned. In this way the subject might be forced to consider both scaling operation and reaction time response concurrently, and the influence of instructional set would have a maximum effect.

Though instructional conditions was not significant, a comparison of mean scale values for each condition does yield some useful information. The scaling operation for faces resulted in high scale values on all scales for faces having curved mouth components. Eye components for the same faces were both curved and straight. This finding, that curved mouth components received higher scale values, is in agreement with Ruckmick's statement, that the mouth is the single most significant feature of the face. It would not be in agreement with Frois-Wittmann's idea that all features are equally important, at least not for schematic faces. This would also account for the discrepancy between eye components for the faces receiving high scale values.

The finding that three of the four faces having low scale values, faces 3, 4, and 7, had straight-line mouths would be expected, as the straight mouth should be most neutral and thus receive less extreme scale values. The reason for faces 2 and 8, a downward curved mouth with downward curved eyes and a downward curved mouth with straight eyes respectively, receiving a low rating on both of the polarity scales is also in accord with expectations. The mean scale values to both of these faces were negative. The third face having a downward curved mouth also has upward turned eyes. This would seem to make the eyes and mouth incongruent with one another and thus have both positive and negative emotion at the same time. No consistent pattern between reaction time and scale values assigned, such as longer reaction time for high scale values or its inverse, seems to exist for faces.

The scaling task for non-faces was concerned with three types of figures: part faces, blanks, and jumbled faces. Three of the four highest scale values for non-faces were assigned by the Ss to jumbled faces. This could be predicted on the basis of complexity of design and being closest in resemblance to a face. The single non-face receiving the highest scale value under three of the four scaling conditions, however, was non-face 14, a part face with upturned eyes. This finding suggests a discrepancy exists between scaling of whole faces and their individual parts. For the whole faces, the mouth seemed to be the dominant feature; this was consistent for highest and lowest scale values. No precedent is known to account for the eyes producing such high scale values. One possible reason for the upturned eyes receiving such a high scale value concerns their order in the set. In order A this non-face follows seven negative or neutral figures, and in order B, it follows six negative or neutral figures and immediately follows one very pleasant or positive face. Though not seeming to be extremely positive by itself, when following negative or more neutral figures the upturned eyes might seem positive in comparison. Even when immediately following a very positive face, number 5, the effects of the negative and neutral series might have the same effect. Another possibility might be a carry-over effect from the extremely positive face.

Non-faces yielding low scale values on more than one scale are numbers 11 and 17. Again, one is a jumbled face and one a part face. Three of the non-faces receiving very low scale values on one scale were part faces, upturned and downturned mouths and straight eyes. The fourth was the blank circle. Two of the non-faces would not seem to warrant the low scale value assigned, the upturned mouth and the jumbled face. Order effect for low scale value to non-faces does not seem to show a consistent pattern as it did for high scale values. All three mouths are included among thos non-faces having lowest scale values.

Again, this seems to suggest that the dominance of the mouth is not of as much importance in the non-face as in the whole face. Since the mouth is not always the determining factor for assigning high and low scale values to non-faces, Frois-Wittmann's idea that the parts are relative to the rest of the pattern would seem to be supported for non-faces. Scale values to non-faces, as to faces, do not seem to follow any consistent pattern with corresponding reaction time measures.

Using schematic faces as stimuli for scaling operations has shown that differences between faces and non-faces and among faces and non-faces can be detected. Schematic faces as stimuli rather than photographs offer a much more simple representation of positive, negative, and neutral emotions. Scales consisting of either positive values or both positive and negative values seemed to yield very similar results for highest and lowest scale values to both faces and non-faces.

The other factor in the present study, direction of response, was also not significant. It was included only to verify that any differences among conditions were due to the different conditions and not to some "nuisance factor". This possible nuisance factor relates to one direction of lever press being easier to make than another direction of lever press. From early examination of results it seemed possible that just such a factor might be contributing a great deal to variation among conditions; however, the final analysis of variance failed to support such a contention. Direction of response, being a part of the initial choice reaction time task, would not have been affected in this study by the time interval between instructions and performance of the task as was the variable of condition to which Ss were assigned. Egeth (1966) using Same-Different judgements also divided his Ss into 2 groups on the basis of response-assignment (i.e., key press). His findings indicated that response-assignment was not significant. Thus, in future research, this factor need not be included as a major variable under study.

The face non-face distinction, although significant, was not in the predicted direction. Faces were found to have shorter reaction times than non-faces, thus the combined emotive and figural properties do not seem to result in longer recognition times for schematic faces. A similar assumption was that the component parts of faces should produce shorter reaction times than the whole face because of fewer dimensions. This assumption, which would have supported a Feature Analysis theory, was found to be in the opposite direction when analyzed.

A number of explanations might be offered to account for these findings. First of all, since the face forms a pattern, a very familiar pattern in everyday life, this pattern is much easier for most people to recognize than a series of parts, jumbled faces, or blanks with which they are much less familiar. Had the pattern been unfamiliar or infrequently seen, this relationship of part to whole or pattern to non-pattern might have been more apt to hold true. Another possible reason for the slowness of response to non-faces as compared to faces was gained from subjects' comments during the task. Although shown the entire series of figures, grouped as to face or non-face, subjects had a tendency to hesitate in responding to the component facial parts. They often stated that the parts should also be considered faces. This hesitation as to which category to place the part-faces was evidently reflected in the Ss slower reaction times to non-faces. A further possible explanation might lie in the choice of type of face used as a stimulus. Schematic faces may lack sufficient complexity to produce the expected difference in reaction time to part components versus the whole face. However, a pilot study reflected differences in reaction time measures to simple scaling operations for part components and whole faces. This distinction found in time required to scale various whole and part components may not exist for a choice reaction time task alone. The complexity of the face, even though a schematic one, might be sufficient to elicit longer reaction times when making a more complex response, i.e., picking a label or assigning to a figure a certain degree of a given characteristic. There may not be sufficient complexity, emotive or figural, to elicit longer reaction times for faces with such a simple choice response as a lever press when the face is the most familiar of all the stimuli presented. The non-faces used in this study were possibly more complex than the faces because they were of three types: blanks, component parts, and jumbled faces.

Several studies also offer possible reasons for shorter reaction times occurring for faces rather than non-faces. Egeth and Smith (1967) using yes-no responses (different keys) found reaction time to be shorter for yes than no responses. "Yes" indicated that the figure was a member of the target set and "no" indicated that the figure was not a member of the target set. The present findings could be interpreted in much the same way. "Yes" or face, in this case, was significantly shorter than "no" or non-face response. This would suggested that face is the main target or "yes" response for which the subject is searching, and all other figures, non-faces, are just incidental stimuli corresponding to a "no" response. This finding is also in accord with Lehr, Bergum, and Standing's (1966) hypothesis, that S's set for attractive stimuli is more clearly defined than for unattractive stimuli and results in a more rapid evaluative decision for attractive items. In terms of the present study, the face would be considered more attractive than the varied forms of non-faces and thus produce shorter reaction times.

Reaction time as a function of errors afforded some interesting results. Responses in error for both faces and non-faces seemed to show a great deal of variation in reaction time as well as number of errors. For instance, mean reaction time for faces having error responses ranged from .31 to 1.08, while mean reaction time for non-faces ranged from .34 to 1.60. In general, error responses to faces produced shorter reaction times than to non-faces.

Both the most and the fewest errors were made to non-faces, the downturned eyes and blank circle respectively. A possible reason for the downturned eyes receiving so many responses in error might be due to the position in the series. In order A this figure appeared first, and in order B it appeared fourth. Thus, in both orders it was one of the first stimuli presented and more likely to receive initial error responses than other figures, most of which were more widely separated numerically between orders A and B. A more complex figure, either a face or jumbled face, would be expected to elicit more error responses. Part faces, however, yielded a larger number of mean responses in error, 15.83, than either faces, 11.22, or jumbled faces, 14. Reaction times for responses in error to part faces also do not seem to be shorter and are often in fact longer than to jumbled faces. Thus, responses in error produced much the same pattern of reaction times to faces and non-faces as did correct responses to the same stimuli.

The present study seems to support a pattern recognition or Template Theory rather than a Feature Testing Theory. The quicker matching process for faces would be accounted for by such a theory in terms of prior memory traces existing for faces but not for the random arrangement of non-faces. Perhaps the schematic face is not as suitable a stimulus object as other stimuli for determining differences between Template and Feature Testing models and parallel versus serial search processes.

CHAPTER VI

SUMMARY

The purpose of the present study was to investigate the interrelationships between the areas of judgment of facial expression and reaction time for this process. This relationship was studied in terms of the effect of instructional set (scaling operation) on speed of reaction time.

A survey of the literature revealed that very little effort has been made to study such a relationship. Rather, most studies dealing with emotive value in faces have been primarily concerned with judgmental scaling procedures or naming processes. Such studies have not attempted to interrelate emotive value of faces with a reaction time measure. Likewise, reaction time measures have utilized stimuli such as words and letters rather than faces as targets. Studies such as that of Bokander (1962) and Lehr, Bergum, and Standing (1966) suggested the possibility of obtaining a reaction time measure to pictorial stimuli having attention or involvement value. This idea was carried out by the use of schematic figures (faces and non-faces) as stimuli in the present study. Schematic figures rather than photographs were selected in an effort to keep the stimulus material as simple as possible and still portray varying degrees of affect.

An analysis of variance for repeated measures was used to analyze the results. It revealed that of the three major factors under study

(Instructional Conditions, Direction of Response, and Stimulus Material) only one, Stimulus Material, was of statistical significance, F (1,60) = 115.17, $p < .001$. The direction of significance, not the one predicted by the initial hypothesis, was in support of non-faces requiring longer reaction times than faces. Neither of the other two hypotheses was supported.

A breakdown of mean scale values to individual figures revealed that the mouth component seemed to be the dominant factor for faces. For highest scale values assigned to individual faces the mouth was either curved upward or downward. A straight line mouth was found for most low scale values assigned. Scale values assigned to non-faces revealed less reliance on one component as being dominant. Highest scale values were, in most cases, assigned to jumbled faces. Low scale values were assigned to parts, blanks, and jumbled faces. Reaction times to faces versus non-faces seemed to follow a consistent pattern. Whether responses were correct or in error, reaction times were shorter to faces than to non-faces for all conditions.

Future research might focus upon a slightly different approach to the effect of instructional set on reaction time. The reaction time measure for each of the 84 stimuli might be immediately followed by a designated scaling task. The scaling task would be differentiated between Ss on the basis of the group to which Ss were assigned. A concurrent scaling operation and reaction time measure would more likely reflect differences due to instructional set.

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Master of Science

Thesis: TEMPORAL AND AFFECT PROPERTIES OF SCHEMATIC FIGURES

Major Field: Psychology

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, September 24, 1946, the daughter of Mr. and Mrs. George Pate; married to Stephen Shry, 1968.

Education: Graduated from Northwest Classen High School, Oklahoma City, Oklahoma, in May, 1964; received the Bachelor of Arts degree from Central State College, Edmond, Oklahoma, with a major in Psychology and Sociology, in May, 1967; completed requirements for the Master of Science degree in August, 1969.

Professional Experience: Served as Psychological Trainee, Del City Guidance Center, Del City, Oklahoma from January through July 1967; Graduate Teaching Assistant at Oklahoma State University, 1967-1969.