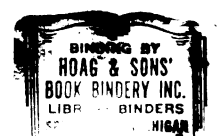


THE BEHAVIORAL CONSEQUENCES OF
ABSTRACT PATTERNS DERIVED FROM
THREATENING SIGN-STIMULUS
DISPLAYS IN HUMANS

Thesis for the Degree of M. A.
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(MALIK FUFUKKA)

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ABSTRACT

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The experiment tested the effect on approach behavior of isolated abstract patterns derived from facial threat displays. It was hypothesized that such abstract patterns would produce a greater distance response, in that subjects would not approach the patterns as closely as they would to control patterns of equal stimulus value.

The experiment followed a 2 x 4 (sex x order) between-subjects and a 2 x 10 (threatening, nonthreatening x pattern positions) within-subjects design. Two random stimulus orders were used to avoid subjects comparing stimuli pairs. Each random order was also presented in reverse order, so that four separate random orders were possible in order to control for sequence effects. Subjects were given instructions to approach each stimuli pattern and stop when they felt comfortable.

Five pattern sets produced significant effects in the direction of the hypothesis, while three pattern sets

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did not, and two pattern sets produced significant reversals. The lack of positive results in certain of the sets also demonstrated the likelihood that there was a strong relationship between threat displays and specific areas of the face.

Accepted by the faculty of the Department of
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for the Master of Arts degree.

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A THESIS

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This manuscript is dedicated to the next Black
man, woman, or child who gives their life for
the liberation of people of African descent.
Effective date 2/11/72, 12:01 a.m.

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INTRODUCTION

The process of intercommunication is certainly of great service to many animals. To the social animals the power of intercommunication between members of the same community, with other species, between the opposite sexes, and between young and old is of highest importance. Primitive man is known to have used inarticulate cries, gestures, and facial expressions long before he "invented" articulate language. In contemporary man, intercommunication is generally effected by means of the voice; however it is certain that his gestures and facial expressions are to a certain extent mutually intelligible. Facial expressions and gestures also support verbal communication, and frequently are used in the place of verbal communication, when appropriate. Although non-linguistic communication has received little attention in psychological literature, there is increasing attention being paid to the use of non-verbal communication throughout the phylogenic scale.

Darwin (1872) was the first to contribute empirical evidence to support the hypothesis regarding the innateness and universality of emotional expressions. By comparing the facial gestures of various mammals, he observed the continuity of expression in animals and in man, the

functional nature of expression, and its role in the communication of lower and higher animals. Darwin concluded that in the course of evolution facial expressions changed in form, through changes in facial muscles, and the original patterns evolved into displays that conveyed a derivative meaning, e.g., threat to the other animals. Endowed with the function of communication they survived from one stage of animal evolution to the next and thus were passed along to man.

Darwin believed reflex actions were due to the excitement of a peripheral nerve which transmits its influence to certain nerve cells, and these in turn excite certain muscles or glands into action. All of this may take place without any awareness of sensation or consciousness on the part of the individual. These reflex actions are in all probability subject to slight variations, as are all instincts. If these variations were beneficial and of sufficient importance, they would tend to be preserved and inherited. Thus reflex actions which were gained for one purpose might be modified at a later time independently of will or habit, so as to serve some distinct purpose. For example, few individuals without practice can voluntarily act on their grief muscles in the face (Darwin, 1872). These muscles are rarely enacted from bodily pain, but almost exclusively from the mental distress (upper

eyelids arched, eyebrows raised, with wrinkles on the forehead) of anticipated anxiety.

In all cases of distress, whether great or small, Darwin believed the brain sends an order to certain facial muscles to contract. When infants begin to cry or are endeavoring to stop crying, they generally control all other facial muscles more effectively than the distress muscles. These muscles are the first to contract and the last to relax. In like manner, those muscles of the face which are least obedient to the will can alone betray a slight and passing emotion without the individual being conscious of their actions. Darwin explains this contraction under the influence of distress by the principle of these facial muscles being least under the control of the will, hypothesizing that they are innate.

To Lorenz (1965) instincts can be characterized by spontaneity with innate behaviors being genetically organized responses. This does not mean that these responses occur without external stimulation. Rather, they require stimuli or elicitors and may also require a particular set of antecedent conditions. However, they do not require specific prior training such as is true for learned responses. It is assumed that if a behavior is innate, different individuals of a species will react to the same stimulus in very much the same way, given similar

antecedent and immediate conditions producing species--specific behavior (Denny & Ratner, 1970).

A display is the term used to label innate actions of animals that seem to function as signals to members of the same species or other species. The message of a display is the information available to an individual as a result of having received the display. This message specifies a class of activities that the communicator may perform at about the time of displaying, or predicts a change in his activities. Because most messages indicate some selection within the behavioral repertoire of the communicator, an investigator recognizes each message by the particular class of behavior associated with the displays that encode it. For example, aggressive behavior consists of displays which induce the withdrawal of intruders. These displays are called threats. A threat consists of a display of innately understood signals which, according to the relative strength of the threatened animal, elicits a counterattack or flight response. A threat, as a near fight, is common in mammals, but a fight is rare among the same species. Usually one of the animals responds with avoidance behavior during the encounter. This withdrawal from attack provides a relief from tension and is also desirable for survival.

In agreement with Lorenz, Tinbergen (1952) showed that some facial expressions are derived from displays

which serve as communication to other animals. Tinbergen stated that animal facial displays produce social changes that seem to aim at one goal, the adaptation to the responsive capacities of the reacting individual. He believed that innate behavior usually responds to sign stimuli, i.e., only few aspects of the total cue situation. Through the social releasers, i.e., displays, animals seem to produce sign stimuli as a result of adaptation. He concluded that displays seem always to release innate, not conditioned responses.

Andrew (1963) went further and showed that the communicative element in a display must be present before natural selection could begin to shape a response into a component display. He states that the association of a particular expression with a high probability of attack, for example, does not mean that the expression is caused by a subjective feeling of anger or by the aggressive drive in the animal. However, the animal acts as though these internal characteristics are operating in the opponent.

In his review of the literature, Izard (1971) reports that the study of emotional behavior in the invertebrates and the lower vertebrates is almost nonexistent. Those researchers who report emotions and emotional behavior in lower animals refer only to overt behavior in two broad classes of responses, approach and avoidance responses. The approach responses are seen as either

social responses and sometimes attacking responses. The avoidance reaction is typically labeled fear behavior. Changes in posture and locomotion are the only way in which the facial muscles system of these lower animals participates in emotion or emotional behavior. Generally speaking, the facial expressions of the lower animals remains incapable of being understood by man.

Higher on the phylogenetic scale, are patterned expressions in birds, i.e., displays. There is good evidence that the displays involving head and facial features are used for social communication and also help to form social orders and relationships. For example, Hale, (1948) and Marks, Siegel, and Kramer, (1960) obtained evidence that the head and facial features of a chicken play a crucial role in maintaining their social dominance order. Alteration or removal of facial features produced a change in the dominance order among the effected chickens. Hale debeaked white Leghorn hens and removed half or more of their upper beak leaving a stump of 1 to 10 mm. The subjects were alpha (dominant) hens of two organized flocks of normal birds. Both hens continued to maintain their dominant position until those hens having most contact with the alpha bird were the first to ignore pecks delivered by the alpha hen. These instances of failure of subordinates to react in a subordinate manner to a considerable number of pecks suggests a weakening of the peck-right relationship,

in the direction of the more loosely organized peck dominance type of social organization. Although the subordinates did not return the pecks, alteration of the hens facial display, not its pecking power, forced the alpha hen to peck more frequently in order to assure the usual degree of dominance.

Similar findings were obtained by Marks, Siegle, and Kramer when the removal of combs and wattles from subject pullets influenced their social position among flocks with non-dubbed chickens. The dubbed pullets were subordinate to non-dubbed pullets. After these large flocks had been housed for 107 days, not a single encounter was won by a dubbed pullet over a non-dubbed bird. This produced a new social stratification within each flock with the dubbed pullets ranking in the lower social positions.

The alteration of facial features as shown in Hale (1948) and Marks, Siegel, Kramer, (1960) can limit the effectiveness of a bird's threat display, producing an incomplete, non-effective fighting response. It should be pointed out that the alteration of the facial features did not limit the subject bird's physical fighting power; however with the facial features altered, the other birds could not respond to the subject bird's threat displays. If dominance in birds and other animals is often determined by the outcome of fighting, it can be inferred that in higher species displays correlated with emotions such as

anger and fear play a part in aggressive acts. Another likely inference is that in evolution, as in the development and maintenance of social order, emotional displays become capable of enhancing or warding off aggression.

The ethological evidence of emotional expression in lower primates suggests that postural activity remains an important element of emotional behavior. In Hinde and Rowell's (1962) careful analysis of emotional expression in the Rhesus macaque monkey, almost all facial expressions are described in context with particular postural or other motor activity. For example, in the threat posture, the mouth is open with the lower jaw slightly protruding, the lower teeth are partly exposed, but the upper ones are mostly covered by the upper lip. The corners of the mouth come forward. The head is jerked forward towards the object being threatened, then returned to its original position. The body is upright with the neck slightly stretched, the eyebrows raised and the eyes are wide open. Sometimes the eyebrows are moved up and down, and the hair is often raised. Threat is thus associated with attacking and fleeing and the precise nature of the posture depends on the spatial relationship between the threatening animal or object.

However, the work of Van Hooff (1967), comparing facial displays of catarrhine monkeys and apes, concludes that the facial displays may become somewhat more

1

independent of posture and locomotion in the anthropoid apes. Van Hooff notes that facial displays in the primates consist of a combination of facial elements in the jaws, the lips, the tongue, the ears, the eyebrows, the upper head skin, the eyes, and the eyelids. Apart from these are displays using postures, movements of the body, and vocalizations. Primate facial displays are related to such basic and objectively definable social behavior patterns as attack, approach, and flight. A tendency to attack is present in animals performing "the tense mouth face" and "the open-mouth face." This also is often the case in a primate showing "the staring bared-teeth scream face." In "the tense-mouth face" and sometimes in "the staring open-mouth face," the upper eyelid is lifted, but the lower eyelid is drawn upward as well to form a straight line. This produces great tension in the region surrounding the eyes, due to a contraction of the muscles controlling the openness of the eyes. The same tense eye display can be seen in man when he is about to attack a rival. In the ape, attack is displayed by staring eyes, a slightly hunched posture, a lowered and forward thrust head, clenched fists, and tightly closed lips. Reviewing Van Hooff's work one notes that "the tense-mouth face," "the staring open-mouth face," "the frowning bared-teeth scream face" are the displays that have a distance increasing or maintaining function. Other displays, e.g., presenting and mounting,

are social releasers whose function is to decrease the distance between individuals. The social releasers show a much greater variability, but are not necessarily associated with particular facial cues.

In man the highly complex and differentiated facial muscular system parallels a highly complex and differentiated emotional system. To man, posture indicates something of the intensity and nature of the felt emotion (either favorable or unfavorable), while a facial pattern may be characteristic of a particular discrete emotion, or communication some information with regard to an emotion mixture. Ekman (1965) hypothesized that head cues convey information primarily concerning the particular affect that is being experienced (anger, sadness, joy, etc.), but provide relatively little information about the intensity of the affect or the level of arousal. Body cues, on the other hand, reverse this pattern, communicating information primarily about the level of arousal or the degree of intensity of the affective experience. Ekman also believed that the body provides few cues to what particular affect is being experienced. In research testing these hypotheses, Ekman used photographs of staged interview situations which were rated by naive judges on three dimensions: Pleasantness-unpleasantness; Attention-rejection; Sleep-tension. The relative weights of the head and body in conveying information concerning felt emotion was tested by presenting

three separate components of each interview situation to the judges. They consisted of a picture of the stimulus person's head, the stimulus person's body up to the neck, and the whole person. The photographs were presented in a random order with each whole photograph and its components representing one of the four dimensions under examination. Each dimension was rated on a 9 point scale. For example, in the dimensions of Pleasantness-unpleasantness, a 1 indicates that the person in the photograph is feeling about as unpleasant or unhappy as imaginable, and a 9 indicates maximum pleasantness.

The results of the head/whole correlations and the body/whole correlations suggested some qualification to Ekman's hypothesis. The ratings of the head and the whole person on the Pleasantness-unpleasantness scale were highly intercorrelated, while there was no observable relationship between the judgments of body and whole person cue versions on this dimension. Thus, the evidence suggests that little information about Pleasantness-unpleasantness is communicated by the body, and that the head area, i.e., facial expressions provides man's communication of emotion. Also these findings supports Van Hooff's conclusions that postural expressions of emotion phylogenetically stopped at the monkey, and facial expressions have become the emotional displays that have developed innately from apes on to man.

In early infancy striate muscle activity in emotion appears as a few distinct facial patterns, mainly as a cry of distress or a smile of enjoyment. The development of other discrete emotions comes with the maturation of the differentiated muscles of the face. These muscles are sufficiently developed by the end of the first year of life for most of the discrete emotion patterns to be exercised (Goodenough, 1931). For example, Fantz (1961) has produced evidence that infants can innately perceive form and prefer the human face to other stimulus configurations. If an infant consistently turns its gaze toward some forms more often than toward others, it must be able to perceive and distinguish among different forms. Working on this premise Fantz developed a visual interest test with 30 infants, ages 1 to 15 weeks. Four pairs of test patterns were presented in random sequence: horizontal strips and a bull's eye design, a checker-board and two sizes of a plain square, a cross and a circle, and two identical triangles. The total time spent looking at the various pairs differed sharply and the more complex pairs drew the greater attention. Moreover, the relative attractiveness of the two members of a pair depended on the presence of a pattern difference. There were strong preferences toward the stripes and the bull's eye and toward the checker-board and the square. Neither the cross and the circle nor the two triangles aroused a significant differential interest.

The differential response to patterns was shown at all ages tested, indicating that it was not the result of a learning process. However, this does not answer the question of whether or not the infant's innate capacity for form perception introduces a measure of order and meaning into his sensations. For an active selection process it is necessary to sort out these sensations and make use of them in behavior.

The facial pattern is the most distinctive aspect of a person, the most reliable form distinguishing a human being from other stimulus configurations. So a face-like pattern would be expected to bring out selective perception in an infant, if anything could. Fantz tested this hypothesis with three flat objects, the size and shape of a head. One was painted a stylized face in black on a pink background, on the second he rearranged the features in a distorted pattern, and on the third was painted a solid patch of black covering the top half of the pink object. The features were made large enough to be perceived by the youngest infant so acuity of vision was not a factor. The three objects paired in all possible combinations, were shown to 49 infants from four days to six months old.

The results were consistent for all age levels. The infants looked mostly at the "real" face, somewhat less at the distorted face, and largely ignored the control pattern. The degree of preference for the "real" face to

The other face was not large, but it was consistent among individual infants, especially the younger ones. The experimenter suggested that there is an unlearned, primitive meaning in the form perception of infants.

Just as evolutionary development created cognitive functions and abilities in man, so it created in him also unique emotions and emotional functions. Tomkins (1962, 1963) divided emotions into positive and negative types. The positive emotions tend to elicit behaviors which sustain them, because they are rewarding experiences. The negative emotions; i.e., fear, rage, and anxiety, tend to elicit behaviors which eliminate them because they are punishing or discomforting experiences. Darwin (1872) anticipated Tomkin's proposal when he observed that if we expect to suffer then we are anxious. It can then be inferred that when the threat of aggression is communicated to an individual through facial displays or expressions, the innate response is an anxiety reaction, and the individual should therefore react accordingly. It is also assumed that if a behavior is innate, different individuals of a species will respond to the same stimulus in very much the same way, because from the point of view of the evolutionary process, the recognition of the threat of aggression assures survival.

It is therefore plausible to expect that there may be specific facial sign-stimuli that human beings

selectively interpret as threatening, and that these displays lead to real behavioral consequences. The present study attempts to test this proposition by examining the degree of actual approach behavior to specific patterns that have been noted, (Aronoff and Barclay, 1971) as indicating threat in human beings. This research tests the hypothesis that:

1. People respond selectively to certain kinds of patterns. When these patterns are perceived as abstract displays people will respond to them differentially.
2. People will respond differentially to abstract displays of threat by standing further back from them than from a neutral display of equal stimulus value, under test conditions of approaching these stimuli from a distance that is beyond the range of effective social interaction.

METHOD

Subjects

Subjects consisted of 64 undergraduate students (30 males, 34 females), enrolled in the introductory psychology course at Michigan State University. They were recruited by the experimenter who spoke to these classes and asked students for their cooperation. Those who volunteered to participate were asked to sign a form giving their name, address, and phone number. Subjects were telephoned two days prior to the experiment and asked to participate. If they agreed they were assigned a specific time to participate in the study.

Stimuli

The stimuli used in the study were derived from the patterns noted by Aronoff and Barclay (1971) that distinguished between threatening and non-threatening facial representations collected from more than two hundred subjects (from Cornell University and Michigan State University). Their subjects were asked to imagine that they were New Guinea head hunters and to draw a war and courtship mask. As it has been frequently maintained (La Barre, 1947; Birdwhistle, 1970) that the representation

of emotion is determined by individual cultural norms. La Barre and Birdwhistle might argue that the subjects' reproduction of the mask was a culturally determined American image and, therefore, the results cannot be generalized to other cultures. However, the characteristics that distinguish between threatening (Pic. A) and non-threatening (Pic. B) facial displays have been found to appear in a similar way cross-culturally. Stevenson (1972) examined masks from nine cultures and an additional mixed sample of nine other cultures and found that threatening masks possessed significantly more of these characteristics than non-threatening masks. Ekman (1971) also reports very strong evidence that similar facial expressions are universally associated with the same specific emotions.

The stimuli chosen for this experiment have been shown by Stevenson to distinguish between threatening and non-threatening masks. From the arrangement of stimuli present indicated by Stevenson, the experimenter selected the stimuli for this study in accordance with the criteria that: 1) the threatening stimuli (Pic. A) were abstract and not obviously aggressive, e.g., not bared teeth, etc.; and, 2) a meaningful control pattern of equal stimulus value existed in the non-threatening display. See Figure 1 for a representation of the stimulus displays that were used in the experiment. Pictures 1-4 represent the four warm up cards that preceeded each trial.

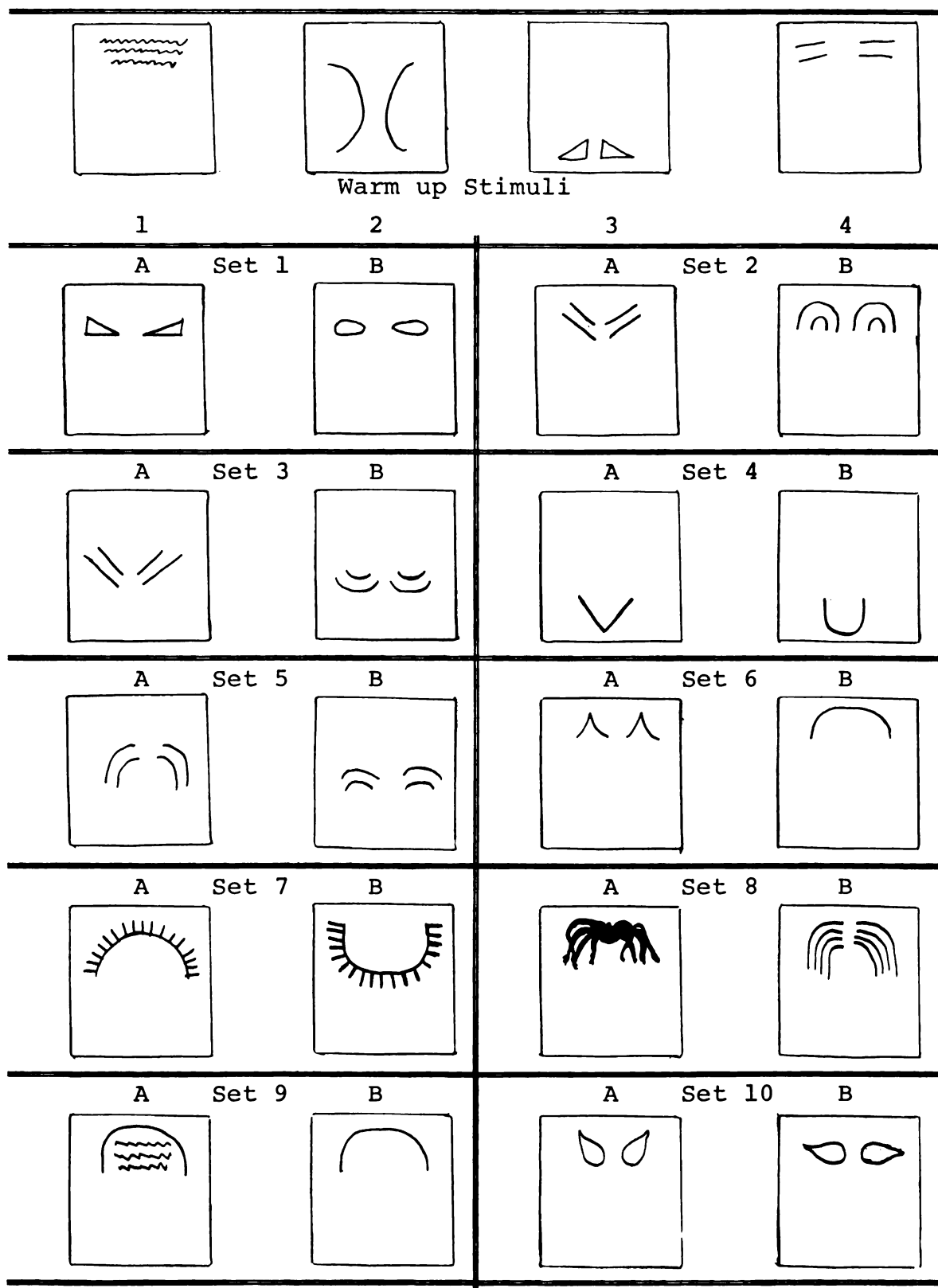


Figure 1

Apparatus

The experimental room measured 38 ft. x 17 ft. and was evenly lit by fluorescent lighting overhead. The stimuli were placed on a 1 inch shelf 5 ft. 2 in. above the floor on the wall at one end of the room. On the floor extending out from the stimuli was a walkway 20 ft. long outlined on the left side with black tape. The Stimuli were placed at a point on the shelf that centered on the walkway.

Against the right wall were a row of classroom tables (5 ft. x 2 ft. 6 in.) lined up lengthwise from the right front corner of the room, so as to be parallel to the walkway and touching the front and right walls. Under the tables on the right wall, the walkway was marked with 80 strips of black tape 3 inches apart and 1-1/2 inches up from the floor. This series of tape marks formed the scale of distance from the wall. The tables, which were the right side boundary of the walkway served the purpose of concealing the scale of distance marks from the subjects.

At the opposite end of the room near the door was set up a table and chair where the experimenter sat during the experiment.

Procedure

The experiment followed a 2 x 4 (sex x order) between-subject and a 2 x 10 (threatening, non-threatening x pattern position) within-subject design. Two random orders of presenting the stimuli were used to avoid subjects comparing the stimuli pairs. Each random order was also presented in reverse order, so that four separate random orders were possible in order to control for sequence effects. The subjects were divided on the basis of sex and assigned an order as they showed up for the experiment. Within the design (2 x 10) the stimuli were being divided into a threatening and non-threatening pair for each of the 10 categories. Thus, eight groups and eight replications of the same experiment were produced. The design is such that the experimenter desired equal N's for each group (per condition) but unfortunately an error in assignment led to unequal cells. There were an additional four stimuli cards (See Figure 1), which were used as a warm up and were always presented in the same order before each of the four experimental orders.

The subjects entered the room and were told to stand at the top of the walkway facing the opposite end of the room from where the stimuli were presented. At this time the experimenter would ask if the subjects wore glasses. If the response was yes, the experimenter would indicate that they may be needed during the experiment.

The subjects were told this was to be a memory experiment and required concentration. Next the subject was told:

In this experiment I shall be putting a series of designs on the far back wall. You will see each one individually and approach them as you wish. When you have reached a spot at which you feel comfortable, stop and indicate to me that you have found that place by saying "here" or "now." Then return to the starting point. You shall always face the opposite end of the room while I put up the design. When I return you may turn around to see the next design. Any questions?
. . . Now begin.

After placing each stimuli card on the shelf, the experimenter, who was unaware of the purpose of the experiment would return to his seat out of view of the subject and tell the subject to start.

Observer

Each subject was observed through a one-way mirror during the walking responses by an observer who was trained in the measuring procedures necessary for the study. The observer noted the subject's distance from the stimulus card on each of the subjects' approach responses. Distance was measured from the wall to the back of the subjects' heel that was furthest from the wall.

Debriefing

At the end of the experiment each subject was debriefed; i.e., given a short explanation of what had occurred and told where they could obtain more information

if desired. Subjects were then thanked for their participation and warned to maintain secrecy in order not to jeopardize the results of the study.

RESULTS

Five pattern sets produced significant effects in the direction of the hypothesis (1, 2, 3, 5, 7); while three pattern sets (4, 8, 10) did not, and pattern sets 6 and 9 produced significant reversals. A test of a possible interaction between order, sex, and direction over the 10 sets of patterns is presented in Table 1. An analysis of these data showed that no significant interaction was present between these variables. The overall summary of the analysis of variance is shown in Table 2.

Table 1. Mean distance in inches by order, sex, and direction of order the S's stood from experimental and control patterns.

Pattern	Order 1		Order 2	
	Up	Down	Up	Down
	M ⁽⁶⁾ * F ⁽¹⁰⁾	M ⁽⁸⁾ F ⁽⁸⁾	M ⁽⁸⁾ F ⁽⁸⁾	M ⁽⁸⁾ F ⁽⁸⁾
A	101.9 133.3	129.9 117.6	144.3 122.4	117.7 128.5
B	100.2 140.1	132.0 114.9	142.2 124.0	113.9 127.7

Note: ()* = N's for each cell.

Table 2 showed a trend in the direction of a 3 way interaction ($F = 3.15$, $p < .08$). An inspection of the means in Table 1 revealed that most of the variation occurred for males in order 1.

Table 2. Between-subjects A x B x C interaction:
(summed over all stimulus patterns).

Source	MS	F Ratio	P Value
Order (A)	254,666.91	.30	.59
Up/down (B)	67,218.37	.07	.78
Sex (C)	69,639.68	.08	.78
A x B	404,250.33	.47	.49
A x C	323,064.43	.38	.54
B x C	127,003.72	.15	.70
A x B x C	2,691,952.90	3.15	.08

[F Ratio = (df(1,58))]

Thus since the above analysis indicated that order and direction can be effectively ignored and since the small N's used to determine the interaction yield effects, which should be considered unstable, the small N's were combined in order to provide more stable effects. These combined data were then analyzed by a multivariate analysis of variance for the sex differences and stimulus pattern effects alone. In this analysis, the cells were thus collapsed into a one by two within (male vs. female) over the 10 sets of patterns, each set consisting of an

experimental and control stimulus which were treated as repeated measures. The summary of this analysis is presented in Table 3.

The stimuli chosen for Set 1 were placed on the upper third of the stimulus card and are representative of eyes (See Figure 1). The right triangles presented in the experimental stimulus were selected to test high facial angularity. Subjects stood further from the threatening (a) stimulus card than they did from the non-threatening card (B) (A distance = 142.6, B distance = 128.0; See Table 4). There were no main effects for sex or interaction. These findings were significantly different. All distances throughout are in inches.

Set 2 was also placed on the upper third of the stimulus card, and represented eyebrow configurations. The experimental stimulus tested the dimension which corresponds to high facial angularity. The findings are represented by the distance totals of 130.5 for pattern A and 120.2 for pattern B, which were significantly different. However, a significant Sex x Pattern interaction revealed the males on Set 2 followed the theoretical hypothesis (distance for pattern A = 134.6, while pattern B = 112.7) ($F = 5.38$, $P < .05$; 1,61 df), although the female mean values did not (pattern A = 126.4 and pattern B = 127.7, non-significant).

The stimulus patterns for Set 3 were placed on the middle third of the stimulus card and represented facial

Table 3. Summary of multivariate analysis of variance on sex differences by individual pattern sets.

Pattern Set	Sex x Pattern Interaction	Pattern Main Effect
1	.09	3.09**
2	3.90**	3.06**
3	.46	5.50***
4	.62	.08
5	2.00*	.64
6	.66	14.60*** (1)
7	.27	1.92*
8	1.65	.01
9	.14	9.86*** (1)
10	.17	.29

[F Ratio = (df = (1,64))]

Note - (1) This is a significant effect due to a reversal (see text for discussion).

- Individual pattern set comparisons were performed by computing t values for the main effects, a procedure suggested by winer (1962, p. 208).

*p ≤ .1

**p ≤ .05

***p ≤ .01

Table 4. Summary of mean distance responses in inches for experimental and control patterns.

Set	Pattern	Males	Females	Total
1	A	134.1	151.1	142.6
	B	117.1	138.9	128.0
2	A	134.6	126.4	130.5
	B	112.7	127.7	120.2
3	A	131.5	130.7	131.1
	B	112.1	120.0	116.0
4	A	126.3	125.2	125.8
	B	120.0	128.2	124.1
5	A	123.8	131.8	127.8
	B	127.7	117.7	122.7
6	A	117.5	116.6	117.0
	B	139.3	150.2	144.7
7	A	138.8	123.5	131.2
	B	125.7	117.6	121.7
8	A	94.4	114.8	104.6
	B	104.3	106.1	105.2
9	A	122.3	107.2	114.8
	B	144.6	135.5	140.1
10	A	125.3	132.1	128.7
	B	131.9	133.0	132.4

tension in the area of the cheeks. The data revealed a significant effect between the patterns with mean totals of 131.1 for pattern A and 116.0 for pattern B. There were no significant main effects for sex; and there were no interactions.

Set 4 symbolized a pointed chin configuration. The experimental stimulus tested low facial angularity. The data showed no significant differences between the distance totals for pattern A (125.8) and pattern B (124.1). There were also no significant main effects or sex interaction presented.

Set 5 was another stimulus pattern placed on the middle third of the stimulus card. The mean distance total for pattern A was 127.8 and 122.7 for pattern B. The experimental stimulus tested mid-facial tension, as did Set 3. These differences were significant overall. However, a significant Sex x Pattern interaction ($F = 2.00$, $p < .1$) showed a slight non-significant reversal of the predicted effect (pattern A = 123.8 and pattern B = 127.7) while females responded in the direction of the hypothesis (pattern A = 131.8, and pattern B = 117.7; ($F = 3.69$, $P < .08$; 1,61 df) a significant difference).

Set 6 stimulus patterns were placed on the upper third of the stimulus card. The experimental stimulus, a configuration of horns, tested a non-human sign stimulus for a human threat response. The mean distance totals

were 117.0 for pattern A and 144.7 for pattern B. These findings reversed the predicted hypothesis and showed no sex interactions.

The stimulus patterns for Set 7 were placed on the upper third of the stimulus card and represented an erection of hair on the head. The experimental stimulus tested whether erect hair would be perceived differently from an inversion of the same stimulus. The mean totals were 131.2 for pattern A and 121.7 for pattern B. These means were significantly different with no (sex) main effects or interaction.

Set 8's stimulus patterns were also represented by hair on the head. Mean distance totals of 104.6 for pattern A and 105.2 for pattern B indicated these findings to be non-significant. Here too, males responded differently (pattern A = 94.4 and pattern B = 104.3) ($F = 3.16$, $P < .09$; 1,61 df) than did females (pattern A = 114.8 and pattern B = 106.1).

Set 9's stimulus patterns were placed on the upper third of the stimulus card. The experiment stimulus tested forehead-tension and represented forehead wrinkles. The mean totals reversed the predicted effect, and were 140.1 for pattern A and 114.8 for pattern B. There were no sex interactions present in Set 9.

The stimulus patterns chosen for Set 10 were placed on the upper third of the stimulus card and were

representative of eyes. The mean distance totals computed 128.7 for pattern A and 132.4 for pattern B. The experimental stimulus tested high facial angularity. These findings were non-significant with no main effects for sex or interaction.

DISCUSSION

Of the two experimental hypotheses, hypothesis two was the major hypothesis tested. Hypothesis two stated that subjects would respond differentially to abstract displays of threat by standing further back from them than from a neutral display of equal stimulus value, under test conditions of approaching these stimuli from a distance that is beyond the range of effective social interaction. Built into the design of the experiment was a strong test of the hypotheses. The use of four different random orders minimized the possibility that the subjects would compare the experimental pattern with its control. This procedure produced significant scores with the use of subnormal stimuli that represented real facial configurations and was therefore a powerful and conservative test of the hypotheses. The results showed that the two hypotheses were, to a great extent, upheld and thus were, in agreement with their theoretical expectation.

The results demonstrated that there was a strong, positive relationship between threat and various areas of the face, as noted from Aronoff and Barclay (1971). In general, contractions in the striate muscle system are present in emotional activity and these contractions form

lines of expression that are peculiar to an individual emotion. The results also indicated that where angularity and diagonality were designated to represent striate muscle activity, i.e., facial tension, subjects produced significant desired effects in the pattern sets 1, 2, 3, 5, and 7. These main findings are in the upper half of the face (from the cheek lines up) and are highly congruent with the early psychological findings of Busby (1924) and Hanawalt (1944). Busby made an analysis of facial expressions based only on the mouth, eye, and eyebrow and concluded the upper parts of the face are more important for correct judgment of facial expression than is the mouth. Hanawalt studied the upper and lower parts of the face in determining their expressive meaning and found that the upper half of the face is most effective in eliciting fear and surprise responses. In this experiment the greatest significant differences from the pattern sets were found in patterns 1, 2, 3, 5, and 7 which were representative of eyes, eyebrows, cheek lines, and erect hair respectively. Stevenson (1972), in using Aronoff and Barclay's scale with threatening and non-threatening masks from nine cultures, found the angularity and diagonality of experimental (Pic. A) patterns 1, 2, 3, 5, and 7 present in the threatening masks. The facial tension that accompanies a threat response seems to converge and be most visible in the upper third of the face and extend down to lower areas of the

cheeks to produce the angularity and diagonality accompanying tension there. Thus, the position of the pattern is important in determining the effectiveness of the angularity and diagonality in the lines.

Pattern sets 4, 8, and 10 yielded nonsignificant differences between the threatening and control patterns. Pattern 4 was a pointed chin configuration, that tested low facial angularity. If it was simply a question of angularity and diagonality versus the absence of these properties, then pattern set 4 would be the best test of the strength of these two elements. However, pattern Set 4 produced nonsignificant scores. Two strong reasons for these results can be considered; either an inappropriate stimulus and/or control was chosen, or the placement (position) of the stimulus was the determining factor. It is unlikely that the control pattern was inappropriate, as the pattern sets discussed above contrast strong angularity and diagonality against curvilinearity and leads to strong positive results. However, according to the findings of Busby and Hanawalt, the latter reason would be true. Stevenson's work also supports the latter reason. She also obtained a nonsignificant score and a slight reversal with the pointed chin configuration.

The experimental stimulus in pattern 10 represented the diagonality of eyes without angularity and was a

pattern from the upper third of the face. The nonsignificant results in this pattern set indicated that position and diagonality alone did not produce the predicted results. It seems that the combination of all three (position, angularity, and diagonality) is necessary for a facial pattern to be seen and responded to as threatening.

Pattern 8 represented hair on the top of the head and tested whether messed and disorderly hair would be perceived as threatening. This, too, produced nonsignificant results. Here, too, it is possible that both the experimental patterns were inappropriately chosen. While it is not fully clear why this pattern did not produce the expected result, it should be noted that it is the pattern most easily interpreted and anthropomorphized. It is likely that when a stimulus pattern is easily anthropomorphized it cannot be considered a sign stimulus for threat, for it may encompass several stimulus properties, i.e., cues, and therefore not be responded to as if it were a single sign stimulus.

Upon reexamination and analysis of the material in this experiment, it is concluded that the reversals present in pattern set 6 and pattern set 9 were partly due to errors in the selection of an appropriate control. It appears this may have been a limitation in the experiment. The configuration of horns (set 6) tested a non-human sign

stimulus for a human threat response. The horn configuration was present in the masks that Aronoff and Barclay studied to obtain their patterns of threat, and Stevenson reports the presence of horns on the threatening masks of the nine cultures she studied. However, when tested as a human facial characteristic it did not yield significant results. If man did not have horns, then horns should not have evolved as a threatening stimulus. Therefore, it is reasonable that horns would not show a significant score on a test of human sign stimuli of threat.

Izard (1971) indicates that, on a post hoc basis, the experimental pattern in set 9 was a wrong selection. Izard presents evidence that the forehead lines in this particular pattern are part of the facial configuration of fear; an obviously non-threatening stimulus. It is unfortunate that the results of Izard's work were not available for consultation when the study was designed.

At present there is not sufficient information available to explain the sex interaction present in sets 2, 5, and 8. Future research is needed to clarify this issue.

The overall results of this experiment have shown that the subjects chose to selectively focus on certain patterns randomly presented to them and produce a behavioral consequences of avoidance, which was the experimenters predicted effect. In the debriefing sessions not one of

the subjects recognized what the desired effect was or how the stimuli elicited their responses. The subjects left the experiment assuming they had just participated in a memory experiment. Such significant differences from approach and avoidance behavior where threat from subnormal sign stimuli was indicated, together with Stevenson's data using the criterion of universality, supports the existence of an innate recognition of threat that is useful for man's survival.

In man, facial expression and gestures support verbal communication, and frequently are used in the place of verbal communication. This experiment was a test of one aspect of nonverbal communication. Whether communication is total or partial without its nonverbal element is a question for future research; however, the existence of an evolutionary history of lines of tension from muscle postures on man's face that are out of his awareness was explored. With the use of his facial tension, man communicates words and meanings that never get verbalized and are seemingly understood within the complexity of everyday face to face interaction.

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