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AN EXPLORATION OF THE "FEAR OF HAWK" HYPOTHESIS USING STATIONARY SILHOUETTED STIMULI WITH NAIVE JAPANESE QUAIL

by

John Stuart Clement

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The relative contribution of heredity and environment in determining the emergence of particular behavior patterns has been a persistent controversy in the study of behavior. Until recently the polarity of the argument was presented by the ethnologists who emphasized the role of genetically oriented explanations and by the comparative psychologists who stressed the learned aspects of behavior.

In more recent years, however, an important shift from the extreme positions has occurred. Tinbergen (1957) has noted that "we tend to say, or tended to say, that this type of behavior is innate and that type of behavior is innate and that type of behavior is learned; now we have learned from experimental biology that this is an improper use of words . . . as far as psychologists can see nowadays, most behavior in the course of development depends on a very complicated interaction between inherent properties and environmental influences." This statement is in good agreement with Hebb (1966) who says that "heredity by itself, can produce no behavior by itself. It is heredity and the prenatal environment that produced the structures in which learning can occur. The two collaborate. Further, it seems highly probable that heredity makes some kinds of learning easy or inevitable, others hard, and thus guides learning." Breland and Breland (1966) have emphasized that learning is not one of nature's most prevalent ways of guaranteeing the preservation and reproduction of the individual or the species. Learning is an advanced "improvement patent," and to view animal behavior primarily within the framework of learning is to miss a great deal of nature's basic program or format.

They continued by saying that the fitness to the environment is by and large determined genetically and embryologically. However, this viewpoint in no way casts learning in a pejorative or derogatory light. It seems to be equally clear that evolution has progressed toward ever more dependence on learning as the mechanism of fitness to a variable and complex environment in the later evolutionary species.

Although contemporary ethnologists and comparative psychologists are becoming more tolerant of each other's views regarding the role of heredity and learning on the behavior of a species, earlier experiments remain which require further elaboration before they can be reconciled with newer views, (Melzack, 1962). One of these is the fear of the hawk-shaped figure in gallinaceous birds.

Several ethnologists (Lorenc, 1957; Tinbergen, 1951; and others cited in Thorpe, 1956) have reported that fear can be elicited in ducks, geese, and other gallinaceous birds by moving a silhouette of cardboard shaped like a hawk with outspread wings, so that it resembles a bird of prey in flight. The critical emotion-provoking aspect of the visual stimulus appeared to be the short neck and long tail characteristic of predatory birds. The same object produced only mild interest when it was moved in the opposite direction emphasizing the long neck and short tail found in most gallinaceous birds. Moreover, Lorenz (1957) has recorded that the fear remained intense over a long period of time without habituation despite the fact that geese he observed were never attacked by a hawk.

Melzack (1959), in a study of mallard ducks reared in a restricted environment, presented somewhat contradictory results to the Tinbergen experiment. Melzack said, "Those ducks which had no earlier experience with flying models showed no fear when the same models were presented in a series of tests. Ducks that had no early experience with the models showed marked fear of the models initially, regardless of shape." There were significantly more responses indicating fear of the hawk than of the goose model in the second series of presentations, but habituation to both models occurred quickly and fear responses to the cardboard models flying overhead were not elicited after the third day of testing. His conclusions indicated that both inherited and environmental factors collaborate in the genesis of fear of visual patterns resembling predatory birds.

Other contemporary research has attacked the traditional Tinbergen model by citing certain deficiencies in his experimental techniques and procedure. Hirsch (1957) reported that none of the previous studies by Tinbergen reported control of certain important variables such as the testing of individual birds and the use of birds with a known developmental history. The Tinbergen hypothesis that certain specifically shaped sign stimuli innately arouse a fear response was tested by Hirsch on the White Leghorn chicken and found to be untenable under controlled laboratory conditions. The hypothesis that certain specifically shaped sign stimuli innately arouse fear must, according to Hirsch, be rejected in the case of the White Leghorn chicken. Rockett's findings were also in disagreement with those of Tinbergen. Rockett (1955) tested twenty White Rock chickens in groups of four on the floor of a livestock pavilion, Leghorn chickens in groups of fifty on an open range and ducks living on a small river. He stated, "I would like to affirm the general conclusions of Hirsch, Lindley, and Tolman that short neckedness is no more fear producing than long neckedness. Schneirla (1959) suggested the more simple explanation of a "shock effect" of the suddenness of stimulus intrusion on the visual field to account for the differential reaction to the two stimulus conditions. It was the size or brusque movement rather than "enemy quality" that seemed to govern initial flight provocation. Finally, Hirsch, Lindley, and Tolman (1955) have stated that fearfulness seemed to be a function of breed, conditions of living (wild versus domestic), and stimulus intensity.

The problem of what can be considered purely innate and what can be considered purely learned or acquired can no longer be adequately explained in either terms. Psychologists and biologists are accepting the idea that behavior actually involves a critical and complex interaction of hereditary and environmental factors. Such a traditional concept as innate fear and avoidance now are concepts which are approached in a new and different perspective. The past tendency to explain these on either a genetic or an acquired basis has been challenged. Miller (1951) has, for instance, stated that because a fear is absent at first and appears later does not necessarily mean that it has been learned, nor on the other hand the fact that an animal fears a stimulus that it has never before experienced does not necessarily mean that this fear is innate. The fear may have generalized along some continuum of similarity with another situation with which it was learned.

The problem of recognizing novelty has become a recent area of concern among experimental psychologists. The various endeavors as of yet are far from conclusive yet need to be mentioned in connection with fear discrimination in a novel context. Thorndike (1899) has stated, that "There develops in the first month a general fear of novel objects in motion." Hebb (1946) has postulated that perceptual patterns defining the familiar must be encoded before the animal can identify novelty. This basis theory has been the locus of much consideration and controversy. Reisen (1958), working with chimpanzees, and Molt and Stettner (1961), using ducks raised animals in plastic hoods that admitted only diffused (i.e., unpatterned) light. When the hoods were removed, the subjects were found to be unafraid of visual patterns that would produce severe fright reactions in normally reared animals. Melzack and Thompson, in agreement with Hebb (1966), found that Scottish terriers reared in isolation would reflexively withdraw from a noxious stimuli (burning cigar) but would make no attempt to avoid a repetition of the stimulus. King (1966), however, has challenged Hebb's position by citing numerous studies in which animals were raised in visually limited conditions, (as opposed to visually deprived). In contrast to the lack of fear in animals visually deprived, those confined from birth in visually monotonous cages were found to be excessively afraid of novel situations. King assumed that rearing in visually limited environments was an appropriate test of Hebb's hypothesis; that is, that visual limitation is a moderate form of visual deprivation. This assumption, however, requires further elaboration. Rearing animals in visually limited conditions does not impede an encoding of the familiar environment. It may be seen that animals of many species do show evidence of fear when confronted by visual novely. The phenomenon has been demonstrated repeatedly in studies of humans, other mammals, and birds, (Bronson, 1968).

Visual depth and form perception are variables which may function in the discrimination of fearful objects. The important consideration involved in visual depth and form perception is what cue or cues could be detected by the animal and could also possess the potential for eliciting fear. The results of various recent experimental designs oriented toward the study of depth and form perception advocate a theory of an innate ability for these types of perception. Naive chicks of certain species were able to detect such differing stimulus qualities as form, solidity, and location of objects. Fantz (1957) cited evidence for the existence of "form preference in the newly hatched domestic chicks." Round stimulus objects received consistently more pecks than angular objects. For preference was shown to a significant degree by dark-hatched chicks during the first ten minutes of visual experience. Hess (1956) stated that the chicks visual apparatus for locating objects in space is innate and not learned. This conclusion was based on the fact that the chicks wearing displacement prisms clustered its pecks about the spot where the object was seen. They did not simply peck randomly until they struck the target. Finally, Fantz (1957) experimented with chicks which had a minimum of opportunity for visual learning and discovered they could discriminate between objects differing in solidity. They responded adaptively to the stimulus difference and tended to peck at solid objects which were more likely to be edible. One remaining variable which merits due consideration is the age at which the avoidance response first appears. Certain variables do affect the age, appearance, the form and the intensity of visually provoked fears. Bronson (1968) has stated that in mammals, attachments to the mother animal normally preceded the fear of visual novelty, with fear being attenuated by the mother animal. Similar patterns were found in precocial birds (birds whose young are able to run about as soon as they are hatched).

While it is generally agreed that the fear of novelty does not appear until some time after birth (or hatching), the mechanism effecting this developmental delay remains a subject of controversy. Some authors (e.g., Hess, 1959; King, 1966) have maintained that maturational processes underlie the development of the capacity for fear and delay its appearance until primary attachments have had an opportunity to develop. An alternate explanation is found in Hebb's hypothesis that encoding of the familiar must precede, and hence will delay, the development of the fear of novelty. Schneirla (1965), has questioned the usefulness of the concept of maturation, claiming that experience must always be a significant factor in any developmental process. Lorenz (1965), however, has maintained that it is possible to identify genetically programmed developments that proceed relatively independently of experience. The issue is difficult and cannot be resolved here, yet the importance of the controversy required at least mention of the various schools of thought.

Preliminary research by the present investigator, indicated that certain configurations of stationary silhouetted stimuli could yield avoidance responses. The original stimuli included such objects as a "hawk" shape and a "pineapple" shape. These were explored to test whether entire configurations or individual stimuli characteristics might be perceived as fear provoking. Since the initial study provided certain fruitful avenues to be researched, the present study was conducted. The purpose of the present study was to explore the possibility that certain stationary silhouetted objects could be effective in eliciting various innate avoidance responses. The technique was to present various pairs of silhouetted stimuli to Japanese Quail. Any behavior resembling avoidance responses was examined closely. If "falls" were obtained with an entire configuration, the individual elements of the configuration were further examined.

METHODS

Subjects

The subjects, 1500 incubator hatched Japanese Quail (Coturnix coturnix Japonica) of both sexes, were approximately 20 hours old then they were utilized in the experiment. Twenty sets of birds (a set contained from 24-60 birds) were hatched with the incubator light on, and six sets were hatched without the light. All quail were placed in holding cartons (10 to 20 chicks per carton) within four hours of hatching and the cartons were stored in the incubator until the birds were used as subjects.

Apparatus

The main apparatus was a large wooden box with a jumping platform installed in the center. The box is pictured in two perspectives in Figures 1 and 2. The box was constructed of plywood with the dimensions 24½" long, 23½" wide, and 23½" in height. The height of the jumping platform was investigated at various levels and eventually set at 19". Previous research (Fatzinger, 1967) discovered this particular height to be advantageous when employing quail in a similar experimental design involving pattern discrimination. The actual jumping platform was six inches square and was covered with corrugated paper to aid the footing of the chicks. For the purpose of observing the chicks on the platform, a panoramic, monocular viewing device was built into the front wall of the box. The floor of the box was partitioned in half by means of a clear plastic divider 1½" in height.

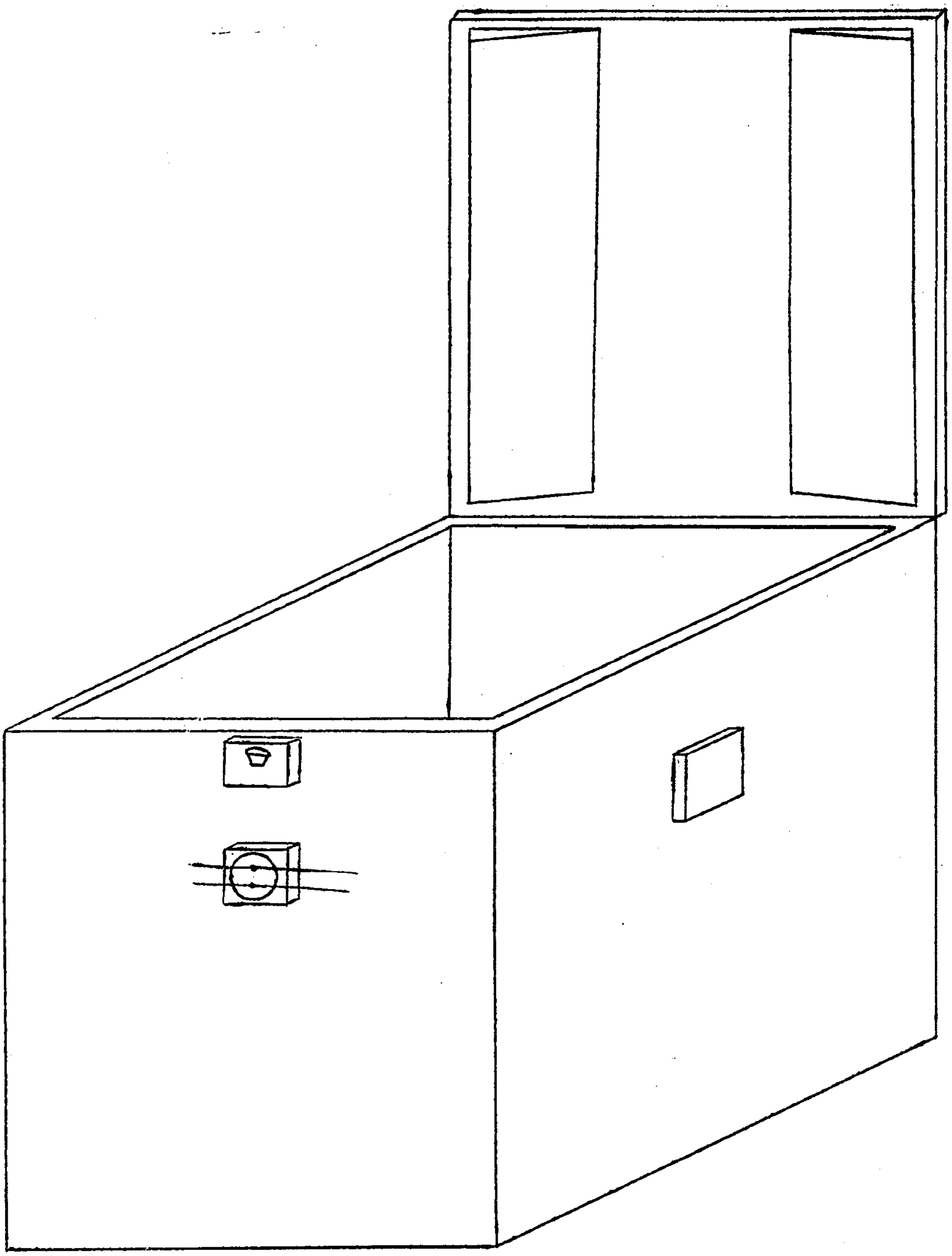

Fig. 1. Jumping box with overhead, illustrating the tent effect provided for the silhouetted configurations.

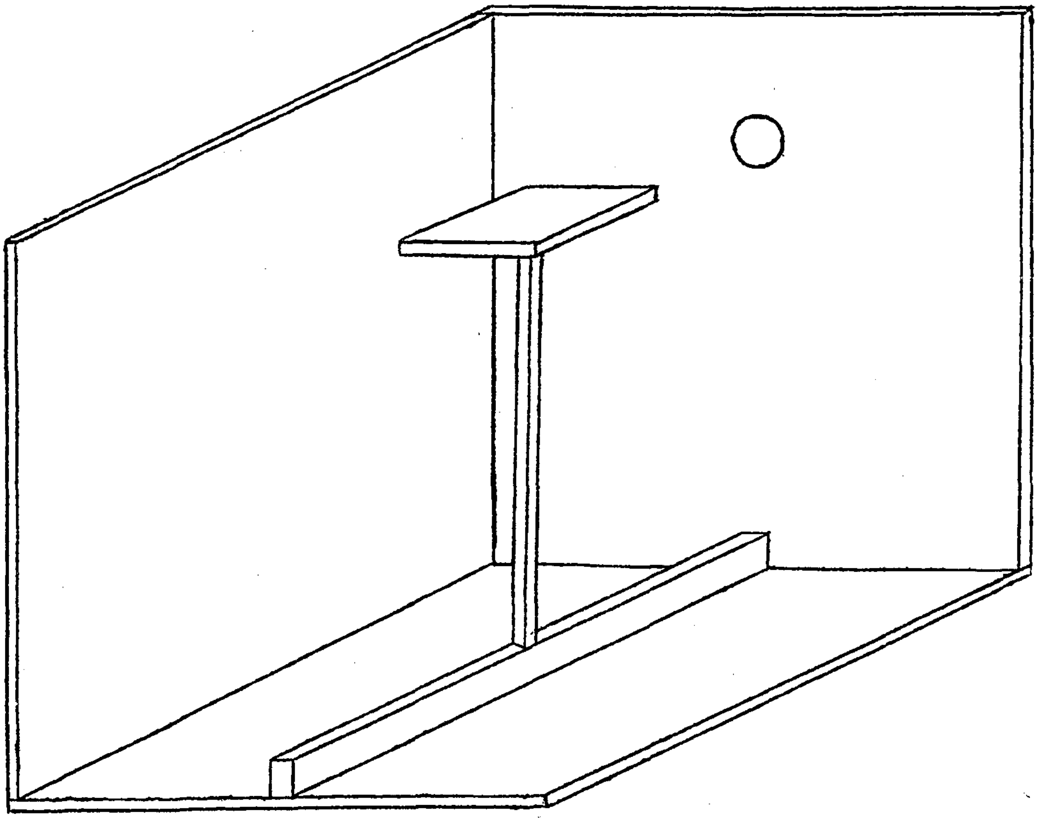

Fig. 2. Internal structure of the jumping box with 19" jumping pedestal.

The function of the partition was to indicate whether the birds were jumping to the right or to the left. The cover of the box was separated into two equal sections which were fitted with two rows of metal grooves 9 3/4" apart and 22 1/4" in length. The purpose of the grooves was to allow for the mounting of silhouetted objects. The two sections were constructed at a 30° angle to the surface of the cover. This method provided a tent effect, so that when the lid was closed the stimuli were only 4 1/2" from the edge of the platform. This arrangement permitted the silhouettes to dominate the visual field of the chicks. Illumination of the box was provided for by four, 7 1/2 watt light bulbs. The bulbs were located one per side and were centered 5 1/2" from the top of each side. The other boxes were located beneath the jumping apparatus. One of the boxes contained the chicks which were waiting to be used. This covered box was 16" in diameter and was heated by a 60 watt heating pad. The other heated box made of cardboard was 16" in length, 12" in width, and 9" in height. This box housed the birds which had already been utilized in the experiment. The two auxiliary boxes were centered two feet beneath the jumping box so that any peeping of the birds would not contribute to a possible position effect. A 100 watt red ceiling light provided the only light which was used during the experiment. Any possible shadow error resulting from extraneous environmental illumination was thus controlled. A stopwatch was used to record the length of time that a chick was on the jumping stand.

Procedure

The chicks began hatching approximately 380 hours after initial incubation. Throughout the first 18 sets of birds, a light remained on inside the hatching incubator. Following these 18 sets, and for the next 4 sets of birds, the incubator light was turned off. Subsequent to these sets the light was once again turned on for two trials. For the final two sets of birds the light was turned off. This precaution of hatching part of the birds with the light and part without the light was used as a control for any possible differences between light and dark hatched birds.

The eggs were observed every four hours as the time of hatching approached. This measure provided a reasonable method for determining the age of the chicks. A flashlight pointed in an obtuse direction, provided the only source of light in checking the newly hatched chicks when dark hatched chicks were being supplied. Each newly hatched chick was counted and placed in a chicken egg carton corresponding to the hour at which it hatched. No more than 24 birds were placed in a single carton. If the number of birds which had hatched in the 4 hour interval was more than 24, extra cartons were used. The chicks remained in the cartons in the incubator until they were 20 hours old (as defined by boxing time) and were then taken in the closed egg carton to the adjacent experimental room. The chicks were placed in a round, heated box and were allowed a ten minute, "quieting down" period. The E now placed his right hand into the box and in a random fashion grasped a chick. The manner of selecting and holding the chick differed somewhat each trial; however, the chick always remained completely inside the grasp of the E. The chick was then placed on the jumping platform and the cover to the box was closed by the E's left hand. Thus, closing the lid and releasing the chick were simultaneous operations. This precautionary measure was taken to minimize the likelihood of a movement or "looming" variable (a visual pattern characterized by a rapidly expanding contour) the chick might detect. If the chick jumped off the platform before the E was able to observe it through the viewing device, the chick was disregarded and another was selected. Time on the stopwatch was now initiated. A chick was disqualified if it remained on the platform in excess of three minutes (arbitrarily chosen because the preponderance of chicks jumped within one minute). If a bird did leave the platform, the time latency was recorded and the cover was immediately raised. The direction of the response was tabulated and the chick was placed into a second heated box. The entire procedure was then replicated for each individual chick; no chick being used more than once. Because there was no prior evidence that a "fall" represented a form of avoidance response, a definition for determining a "fall" was necessitated. The basic negative response in chicks of gallinaceous birds and waterfowl according to Hirsch (1962) is to withdraw or to crouch. More recent research by Fatzinger (1969) did not yield any significant numbers of "falls" when quail were tested in a pattern discrimination task. Although the E's perceptual interpretation was of course the inevitable determinant, an attempt was made to establish an objective criterion measure for the evaluation of a "fall". A "fall" was recorded any time a bird tripped or apparently misjudged the proximity of the platform edge, leaving the platform by means other than jumping. Therefore, a "fall" was recorded if the chick did not have control of itself, showing definite lack of coordination.

The silhouettes were systematically reversed right to left so that when two stimuli presentations were used a stimulus appeared as many times on the right as it did on the left. This precaution was used in all tests and counterbalanced for any positional effect.

The stimuli utilized in the discrimination task were pairs of stationary, silhouetted objects. These various silhouettes are presented in Figures 3, 4, and 5. At the inception of the experiment the intent was to replicate the basic Tinbergen experimental model with certain modifications. The first silhouetted stimuli included two "hawk" and one "pineapple" configurations. Two perspectives of the "hawk", a "flying hawk" and a "sitting hawk," were tested against a stone (a simple circle, 3" in diameter) and a totally black panel. The "pineapple" (an object resembling a pineapple top with curved, irregular spines) was likewise explored against the stone and black panel. Subsequent to these trials, the "hawk" and "pineapple" configurations were replaced by a new, multiangular object (the object was conceptualized as a very stylized hawk). This object was examined against a black panel as well as in opposition to itself: 1) in either an inverted versus upright fasion, 2) where both figures were identical except that one was reversed left to right, and 3) in identical forms against each other.

Following these trials, the multiangular object was divided into

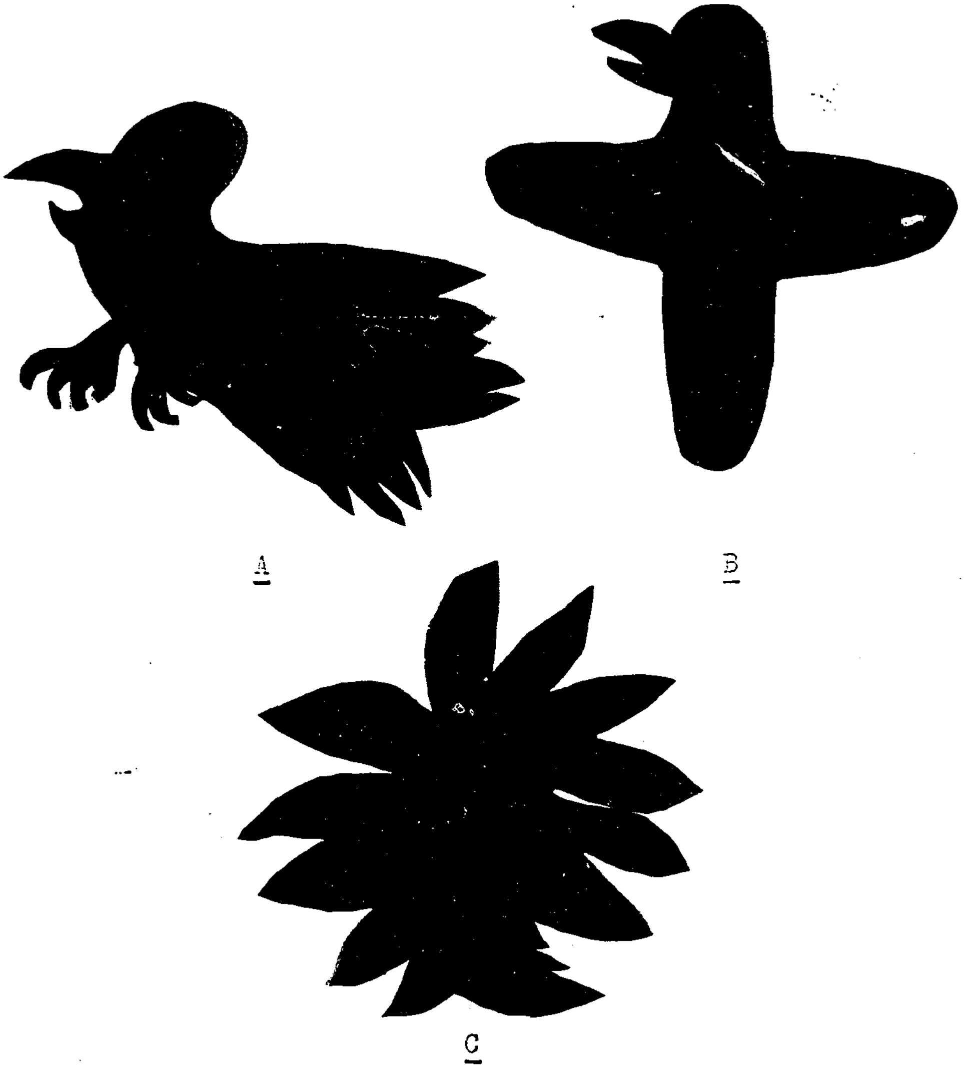

Fig. 3. Stationary silhouetted configurations used to elicit avoidance responses in Japanese Quail: A) Sitting Hawk (8" by 14"), B) Flying Hawk (9 1/4" by 11 1/2"), C) Pineapple (6" by 8").

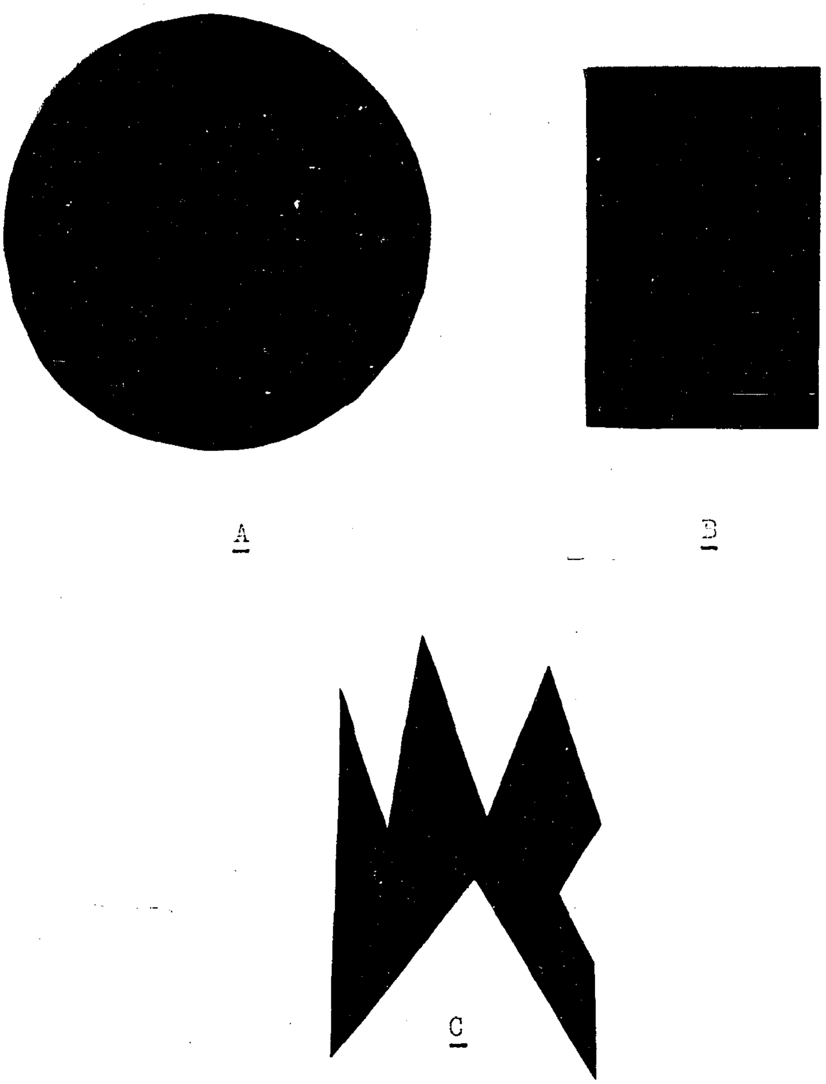

Fig. 4. Stationary silhouetted configurations used to elicit avoidance responses in Japanese Quail: A) Stone (2 1/4", 3", or 4 1/2" in diameter), B) Black panel (10" by 22"), C) Multiangular object (8 3/4" by 11 1/2").

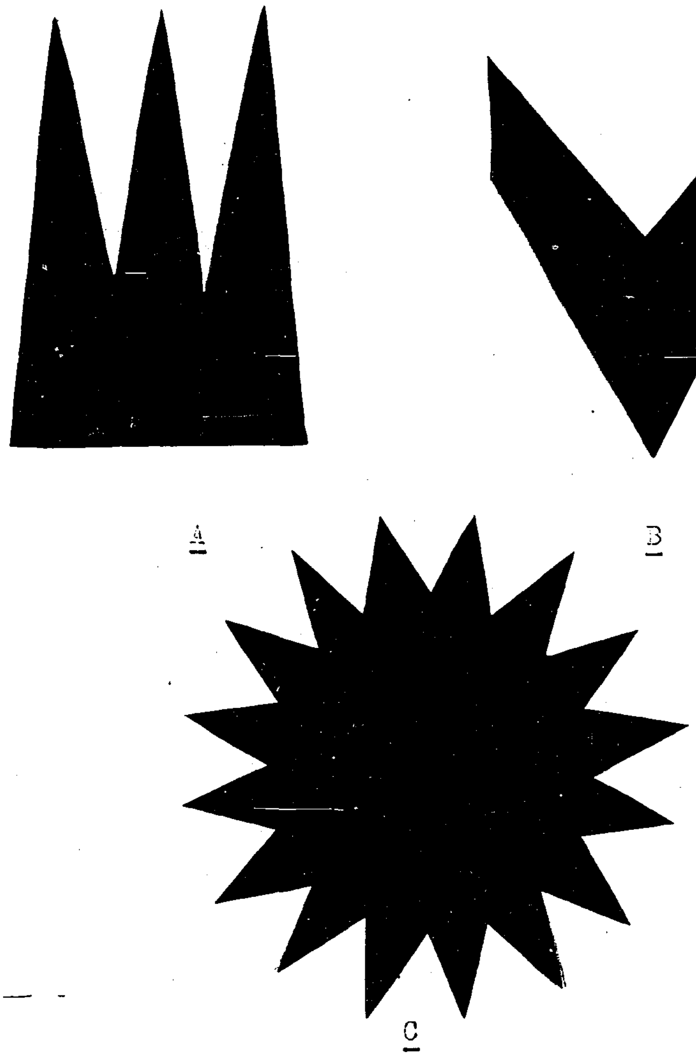

Fig. 5. Stationary silhouetted configurations used to elicit avoidance responses in Japanese Quail: A) "Flying W" (7 3/4" by 8 1/4"), B) "Flying V" (6 3/4" by 10"), C) Spiked circle (2 1/2" spikes or 1 3/4" spikes).

its two integral parts; a "flying W" shape and a "flying V"shape. The "flying W" was investigated in all four possible rotations against a black panel and in opposition to itself, with one "flying W" pointing away and to the right of the chick, the other pointing away and to the left. The other element of the multiangular object, a "flying V," was tested with separate sets in both an upright and inverted position against a black panel.

The next series included a sequence of spiked circles, 4 1/2" in diameter. Each circle was equipped with 16 spikes. The first and most extreme circle had 2 1/2" spikes with the spikes on the three succeeding circles decreasing in length until they approached a smooth circle. The diameters of the spiked circles, (4 1/2" measured to the outside periphery of the spikes) were equivalent to the diameter of a new stone, (4 1/2" in diameter) and remained constant as the spikes gradually diminished in length. Because the outside diameters of the spiked circles and the new stone coincided exactly, and area differences in the silhouettes were minimized.

The spiked circles were paired with either a stone or another spiked circle. When the original 2 1/2" spiked circle was cut out, the razor left a serrated edge. The E ran the "fuzzy edged" circle against the 4 1/2" stone but the "fuzzy edge" was considered to represent a possible cue for food so that a second, "clean" 2 1/2" spiked circle was required for control. For even tighter control the "fuzzy edged" 2 1/2" spiked circle was tested against a 1 3/4" spiked circle, the next in the series. Following these sets, the "clean" 2 1/2" spiked circle was run in opposition to the original pineapple figure to predict whether a possible symmetrical or angular cue was the operating physical property for effective fear responses.

The last section of the experiment investigated the possible differences in jumping behavior between dark and light reared chicks. Four sets of chicks were run, two representing light hatched chicks and two representing dark hatched chicks. The stimuli objects chosen for discrimination were the pineapple and multiangular objects. The selection of these two particular configurations was based on the number of "falls" these two stimuli originally provoked.

RESULTS

The Chi Square analysis was used in the evaluation of the data, since over 20 comparisons were to be made in evaluating the results. The standard .01 level of significance was accepted as a reasonable substitute for the .05 level. The degrees of freedom were always one with the Chi Square value 6.63 required for significance.

The results indicate that when the original "hawk" perspectives were tested against a stone and black panel, the "flying hawk" silhouette elicited many more interesting findings than the "sitting hawk." A Chi Square value of 4.56 computed for the "flying hawk" object versus the stone, although not significant, exceeded the Chi Square value of .36 obtained when the "sitting hawk" object was tested against the stone. No significant differences in jumping tendencies were exhibited when the "pineapple" was compared with a stone and black panel. However, a large proportion of "falls" (23%) was distributed throughout this series. The results of the multiangular series disclosed that only when the two multiangular figures were tested against each other (Identical excepting one was reversed left to right) was there a relatively high Chi Square obtained (5.40; not significant). Many other possible positions (using pairs of the multiangular object) were examined but none of the differences were significant. Attention should be called to the 13 "falls" obtained when the multiangular object was tested against a black panel.

Subsequent to testing the multiangular object the figure was broken down into two smaller parts. A "flying W" (one component) was investigated in all four rotations against a black panel. Three of these directions yielded no response differences. However, when the "flying W" was viewed pointing away and to the right of the chick, jumping behavior was in the ratio of approximately 2:1 toward the "flying W" (Chi Square was 6.76, significant at the .01 level). The "flying W" was also examined in opposition to itself. When one "flying W" pointed away and to the right of the chicks and one pointed away and to the left, the configuration yielded a Chi Square of .26 (not significant). The other part of the original multangular object, a "flying V," was investigated in two directions against a black panel. In one test the "V" pointed away and to the right of the chick, while in the other the "V" pointed away and to the left. The obtained Chi Squares were 2.40 and 1.06 respectively; neither significant.

The next series included a sequence of spiked circles. Tabulation of the results revealed an approximate 2:1 response ratio (Chi Square was 6.12, extremely close to the critical value required for significance) when the initial 2 1/2" "fuzzy edged" spiked circle was run against a stone. This result, although not significant, was interesting and led to a second test utilizing a new, "clean," 2 1/2" spiked circle which produced a response ratio of approximately 1:1. The "fuzzy edged" 2 1/2" spiked circle was also examined against a 1 3/4" spiked circle but the obtained Chi Square of .26 was not significant. A comparison of the 1 3/4" spiked circle with the stone yielded a 1:1 jump ratio. To control for a possible size variable, the 4 1/2" stone was run against a new 2 1/4" stone circle. This silhouette pairing resulted in an approximate 1:1 jumping ratio. Finally when the original "pineapple" was investigated against the "clean" spike, the obtained Chi Square was only .28.

To explore the possibility that any differences in the magnitude and direction of responses could be attributed to post-natal experience with an incubator light, light- and dark-reared chicks were compared. Light hatched chicks were placed in an experiment involving the "pineapple" and the black panel. The chicks jumped 34 times to the "pineapple" and 22 times to the black panel. The computed Chi Square was 2.90 for this trial (not significant). Jumps were also recorded when the light-reared chicks were forced to discriminate between the "multiangular" object and the black panel. This pairing yielded 39 jumps toward the multiangular object and 21 jumps toward the black panel. The Chi Square in this instance was 5.40, approaching significance. Using light-reared chicks, a comparison of jumps toward a pattern, regardless of which pattern (in this case either the "pineapple" or multiangular object) as well as toward the black panel produced a Chi Square of 7.76 for the combined trials. This Chi Square was significant at the .01 level. The control for the next test was a replication of the above procedure with the exception that the chicks were dark hatched. This time the chicks jumped in a ratio of 31 to 24 in favor of the "pineapple" but only 29 to 28 times in favor of the multiangular object. The total Chi Square (for dark-reared chicks) for jumps toward the black panel versus patterned jumps was considerably lower (.58) than the Chi Square of 7.76 for light hatched chicks. Chi Square was also computed for difference in jumps that light hatched chicks made when the original hawk object were tested against a stone or black panel. Chi Square in this case was only .20. Data from light and dark hatched chicks were separated and compared for differences in jumping tendencies when all patterned objects (excepting the two original hawk perspectives) were tested against either the black panel or the stone. The Chi Square was only .12 for dark hatched chicks, but 13.78 for the light hatched chicks, significant at the .01 level.

Finally, Chi Square was computed for total right versus left jumps to determine whether a possible position effect was operating. Chi Square was not significant (1.32).

Jump	Fall	Total	Chi Square	Total	Fall	Jump
14	1	15	4.56	31	4	27
Flying Hawk			Light Reared		Stone	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
17	3	20	.36	24	7	17
Sitting Hawk			Light Reared		Stone	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
43	5	48	2.78	33	8	25
Flying Hawk			Light Reared		Black Panel	

Table 1. Chi Square for total responses (jumps plus "falls") of Japenese Quail to pairs of stationary silhouetted stimuli.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
12	3	15	.28	18	6	12
	Pineapple		Light Reared		Stone	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
13	2	15	1.50	9	1	8
	Pineapple		Light Reared		Flying Hawk	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
35	15	50	.74	59	10	49
	Pineapple		Light Reared		Black Panel	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
54	6	60	.90	50	7	43
	Multiangular Object		Light Reared		Black Panel	

Table 1 continued.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
29	2	31	.06	29	2	27
Multiangular Object			Light Reared	Identical Multiangular Object		

Jump	Fall	Total	Chi Square	Total	Fall	Jump
34	5	39	5.40	21	3	18
Multiangular Object			Light Reared	Multiangular Object, reversed left to right		

Jump	Fall	Total	Chi Square	Total	Fall	Jump
32	1	33	2.20	22	1	21
Multiangular Object			Light Reared	Inverted Multiangular Object		

Jump	Fall	Total	Chi Square	Total	Fall	Jump
30	3	33	6.76*	15	1	14
Flying W pointing away and to the right of the chick			Light Reared	Black Panel		

Table 1 continued.

*Significant at the .01 level.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
13	0	13	.04	12	0	12
Flying "V" pointing away and to the left of the chick			Light Reared		Black Panel	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
21	0	21	.68	16	0	16
Flying "V" pointing			Light Reared		Black Panel	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
21	4	25	.82	19	1	18
Flying "V" pointing down and away from the chick			Light Reared		Black Panel	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
34	2	36	2.40	24	0	24
Flying "V" pointing away and to the right of the chick			Light Reared		Black Panel	

Table 1 continued.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
30	4	34	1.06	26	4	22
Flying "V" pointing away and to the left of the chick			Light Reared	Black Panel		
Jump	Fall	Total	Chi Square	Total	Fall	Jump
34	5	39	6.12	20	2	18
2 1/2" fuzzy edged spiked circle			Light Reared	4 1/2" Stone		
Jump	Fall	Total	Chi Square	Total	Fall	Jump
26	3	29	.48	24	0	24
1 3/4" spiked circle			Light Reared	4 1/2" Stone		
Jump	Fall	Total	Chi Square	Total	Fall	Jump
28	0	28	.26	32	0	32
2 1/2" fuzzy edged spiked circle			Light Reared	1 3/4" spiked circle		

Table 1 continued.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
24	0	24	.08	26	0	26
4 1/2" Stone			Dark Reared		2 1/4" Stone	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
25	0	25	0.0	25	0	25
2 1/2" spiked circle			Dark Reared		4 1/2" Stone	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
31	0	31	.28	27	0	27
2 1/2" spiked circle			Dark Reared		Pineapple	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
39	0	39	5.40	21	0	21
Multiangular object			Light Reared		Black Panel	

Table 1 continued.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
34	0	34	2.58	22	0	22
Pineapple			Light Reared		Black Panel	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
29	0	29	.02	28	0	28
Multiangular object			Dark Reared		Black Panel	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
31	0	31	.90	24	0	24
Pineapple			Dark Reared		Black Panel	

Jump	Fall	Total	Chi Square	Total	Fall	Jump
73	0	73	7.76*	43	0	43
Pineapple and Multiangular object combined			Light Reared		Black Panel	

Table 1 continued.

*Significant at the .01 level.

Jump	Fall	Total	Chi Square	Total	Fall	Jump
60	0	60	.58	52	0	52
Pineapple and multiangular object combined			Dark Reared		Black Panel	
Jump	Fall	Total	Chi Square	Total	Fall	Jump
74	9	83	.14	88	19	69
Hawk Perspectives			Light Reared (Combinations of old data.)		Stone or Black Panel	
Total Responses				Total Responses		
428			13.78*	326		
Patterned objects (not including Hawk perspectives)			Light Reared (Falls Excluded)		Stone or Black Panel	
Total Responses				Total Responses		
168			.12	162		
Patterned objects (not including Hawk perspectives)			Dark Reared (Falls Excluded)		Stone or Black Panel	

Table 1 continued.

*Significant at the .01 level.

Total Responses		Total Responses
758	1.32	714
Left	Light and Dark Reared (Falls Excluded)	Right

Table 1 continued.

DISCUSSION

Although the literature contains numerous studies on escape and "fear" responses to various natural and naturalistic objects by young gallinaceous birds and waterfowl, little critical work has been done on the basic physical properties of objects eliciting such responses or on the development of discrimination of "effective" frightening stimuli (Shaller and Emlen, 1962). The hypothesis that certain stationary silhouetted objects could elicit avoidance responses in Japanese Quail was explored in the present study.

The basic supposition at the beginning of the study was to retest the Tinbergen hypothesis using different experimental tactics. The present study abandoned the moving stimuli that Tinbergen used and concentrated on the presentation of stationary silhouetted stimuli. The E initially designed two stylized hawk perspectives. The results of testing these hawk objects against a stone or black panel indicated that light reared chicks responded to these pairs of presentations by jumping in approximately a 1:1 ratio. However, a large proportion of "falls" were noticed. The E realized that this sample of birds were all light reared and any further research should use both light- and dark-reared birds as a control measure. The investigator also acknowledges that his hawk designs may have been more artistic than naturalistic and accepts the fact that a more optimal (Naturalistic) hawk model would be desired in further experiments. It is at this point in the experiment that the E may have been seduced by his preoccupation to deal with the elemental factors of the various configurations. Rather than further explore the original hawk perspectives, the investigator assumed that it was the specific stimulus geometric qualities within the entire hawk silhouette that were functioning as the effective stimulus properties for eliciting fear. The E neglected any further trials with the hawk and followed what appears to be a tortuous rendez-vous with the various elemental features of the original hawk stimulus.

A "pineapple" configuration (made at the same time as the hawk object) was explored, under the assumption that the object contained certain critical features which were capable of eliciting fear. The results of pairing the "pineapple" figure against a stone and black panel again revealed a large number of falls. A new multiangular object was designed to accentuate the angularity and sharp edged characteristics of the original hawk silhouette. This object, while eliciting a relatively large number of "falls," did not produce any differences in directional jumping responses.

The phenomenon of "falling" alluded the investigator for the remainder of the experiment with only an occasional "fall" being registered subsequent to testing the original hawk, pineapple and multiangular configurations. The extreme shift from a high frequency of "falls" to a minimum number of "falls" in later sets of birds may be attributed to either an unconscious variation in the investigator's methodology with those particular sets where the "falls" were so prevalent or to a possible uncontrolled and unrecognized variable in the chicks past experience.

The results of running a "flying W" (one constituent of the multiangular object) against a black panel, yielded no differences in results in three of the four rotations. However, when the "flying W" pointed away and to the right of the chick an approximate 2:1 jumping response (significant at the .01 level) occurred toward the angled object. At this point in the experiment it became evident that the chicks were perhaps preferring the patterned or more complex of two stimulus presentations. It appeared to be difficult, however, to ascertain whether a chick was approaching or avoiding a specific silhouette. It may be the chick feared both pairs of configurations and merely jumped (or fell) off the pedestal as a means of escape, irregardless of the side. Schneirla (1962) reported it was massive retinal stimulation across the visual field of the animal which caused avoidance responses. His theory postulated an approach-avoidance paradigm, in which an animal would approach a low intensity stimulus and avoid a stimulus of high intensity.

The selection of the series of spiked circles was designed to supply a test of the variables of angularity, regularity and symmetry. Only two in the series of four spiked circles were tested since it was assumed that if the extreme spikes of this series were utilized first with no differences in jumping behavior, the other two would conform. Further attempts to evaluate the role of these variables was provided in the test of the 2 1/2" spiked circle against the original "pineapple" figure. The 2 1/2" spiked circle was characterized by symmetrical and regular spikes and angles, while the corresponding, asymmetrical, pineapple configuration was composed of irregular spikes and angles.

The 2:1 response measure which was obtained when the original 2 1/2" "fuzzy edged" spiked circle was tested against a stone, must be attributed to either chance or a faulty method of investigation. However, the investigator was cognizant of the age of the birds and to his knowledge, performed the experiments exactly the same for each set of birds. When the initial 2 1/2" spiked circle was cut out, an unnoticed serrated edge was present. The "fuzzy edged" spiked circle in turn resulted in an approximate 2:1 response ratio when it was tested against the 4 1/2" stone. Although this difference was not statistically significant, the results were promising. The investigator's inclination was to believe the resulting "fuzzy edge" may have represented a food cue to the chick, thus contributing to the approach tendencies. To check this possibility, the "fuzzy edged" spiked circle was tested against a 1 3/4" spiked circle and a new, "clean," 2 1/2" spiked circle was examined against the 4 1/2" stone. In neither new set was there a predisposition to jump toward one silhouette more than another. An alternative explanation for this phenomenon is derived from the overall tendency of light hatched chicks to jump to the patterned or more complex of two stimulus presentations. In this instance the chicks jumped toward the patterned and complex circle more often than the unpatterned and less complex stone silhouette.

The possibility of approach or avoidance being contingent on the size of the stimulus was eliminated by testing a stone, 4 1/2" in diameter, against a stone, 2 1/4" in diameter. Tinbergen (1952) stated that a circle does not release an escape response. This is in disagreement with Hirsch (1962) who reported that he used circles of various sizes as stimuli and obtained definite fear responses with naive chicks provided the diameter exceeded 4" in diameter. The 1:1 response ratio of this study (obtained when two stones of different diameters were tested against each other) is in agreement with Tinbergen's findings.

Shaller and Emlen (1962) also determined what effect visual curtailment had on the rate of development and strength of avoidance responses. Chicks were raised with continuous visual access to a section of the room through a large open window. The results indicated that the sophistication acquired through this greater visual experience had little effect on the rate of development of avoidance behavior but served to depress the ultimate level of response. In the present study, like- and dark-reared chicks were compared for possible differences in the magnitude of avoidance responses and perception of form. The results indicate that light-reared chicks exhibited a significant trend for approaching patterned configurations as opposed to non-patterned or less complex stimuli.

Post-natal experience with the incubator light may have transferred into the discrimination task. The chicks may have encoded (to use Hebb's term) familiarity with, or the ability to perceive pattern or forms. The novelty of the discrimination task may have provided an opportunity for the chick to rely on its previous experience with light, thus accounting for the approach responses toward patterned rather than non-patterned configurations.

The chicks were handled on two different occasions before the actual experimentation took place. During the hatching period, the

E removed any chick that had hatched and placed it in an egg carton. The E also handled a chick as he positioned it on the jumping pedestal. The sudden, "looming" effect on the E's hand coming directly toward the chick produced a startle and withdrawal response. The E's hand may have been perceived in a variety of ways. Perhaps the cues of angularity, symmetry, or overall form were detected. Another possibility was that the "looming hand" was encoded or imprinted as an effective stimulus. Since the light-reared birds significantly more often jumped to a patterned or more complex object, experience with a lighted environment and the "looming hand" may have determined the chick's response to certain test stimuli. Although dark-reared birds exhibited similar startle and withdrawal responses they did not jump more often to patterned stimuli.

The investigator speculated that light experience in combination with previous encounters with the E's hand may be related to the jumping differential of light- and dark-reared chicks. The investigator admits he has denied the reader sufficient explanation for the role of handling and post-natal visual experience on perception. A more careful control of the immediate developmental history of the chicks would be desirable.

The E proposes that more extensive research is justified, since particular, stationary, silhouetted objects were, in fact, able to elicit certain avoidance responses, (i.e., "falls"). The E acknowledges the probability that even a tighter control of light cues would be advantageous. A more systematic and consistent exposure to the pretest lighted environment should also be instituted for the light hatched birds. One alternative suggestion for the procedure would be to dark hatch birds directly in cartons and (after 20 hours in the incubator) transfer them to the heated box, leaving them in the cartons until they could be used. Secondly, a light switch could be installed on the jumping box, providing complete darkness in the jumping box until a bird could be placed on the pedestal and the lid closed.

The results of the present study suggest that certain stationary, silhouetted stimuli were able to elicit a particular form of avoidance response (i.e., "fall") in Japanese Quail. Although a "fall" has never before been used as a fear response indicator, the results of this research indicate that this type of behavior may be a usable dependent variable. This recommendation assumes that a hawk or stylized hawk perspective or some improved silhouettes or pictures of hawks be used as test objects. A tighter control of the scoring of a "fall" is also recommended. The objectivity of the present scoring of a "fall" is suspect, but the obtained relatively high number of "falls" to the hawklike figures in contrast to the low number of "falls" to the simpler angular figures is considered to be worthy of further investigation.

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