

THE GENESIS OF THE CAT'S RESPONSES TO THE RAT

ZING YANG KUO

Psychological Laboratory, University of Chekiang, Hangchow, Chekiang, China

I. INTRODUCTION

The experiments on the rat-killing behavior¹ of the cat by Berry (1) and by Yerkes and Bloomfield (8) have been so widely quoted that it seems unnecessary to restate them here.

Watson's objection (7) to Berry's experiment is that Berry began his test too late so that the instinct of the cat had waned through disuse. McDougall and his son (5) in their incidental observation found that their kitten killed gray wild rats, but were either friendly, or paid no attention, to the albino rat, adult as well as young. McDougall suggested that the odor of the gray wild mouse was "specific excitant of the devouring instinct." A similar result was also reported by Rogers (6). But Rogers seems to think that the wildness of the gray mouse was responsible for its being devoured by the kitten for the other four kittens of the same litter showed no tendency to kill the gray mouse which was not so wild as the one killed by kitten 5. Attention is called to the fact that McDougall's kitten was brought to the laboratory at the age of three weeks. He had no knowledge concerning the kitten's life during first three weeks.

It must be noted that the experiments cited above were all concerned with the problem whether the rat-killing behavior in the cat could be performed without previous practice or without previously seeing the similar performance by adult cats. The problem of the investigation to be reported below is, however, not so simple as this. *We were not interested in proving or disproving that rat-killing behavior in the cat could be performed without practice or social influence.* We went much further than this. Through

¹ The reader should note that the author uses the term rat generically and therefore as inclusive of what are popularly designated as rats and mice.

the observation by Yerkes and Bloomfield, and particularly through our own observation previous to this systematic investigation, we were quite convinced that many cats could kill rats without previous practice or social influence. *But we wished to find out how differently kittens would respond to the rat, when they are brought up under different laboratory conditions.*

Since in the studies cited above the investigators were interested merely in finding out whether or not the kitten could kill the rat without learning, they took no pains to *manipulate* the kitten's living conditions other than preventing it from seeing adult cats in the act of killing rats. So simple a procedure can hardly have much value because the results so gained do not add to our knowledge in controlling or predicting animal behavior, which is the fundamental end of behavior investigation. In our own study, our aim was to manipulate the conditions in which the kitten is made to live so as to see what variations in its behavior toward the rat might be brought forth. The conditions which we varied in the hope of producing variations in the kitten's responses to the rat were as follows:

II. THE PROGRAM

Condition 1. Kittens raised in isolation. In this condition, the kittens were kept from other animals, as soon as they were taken from their mothers. The detailed description of the experimental procedure in this condition will be given in section III.

Condition 2. Kittens raised in the rat-killing environment. In this condition the kitten was kept with its mother, who was a rat-killer. The mother was from time to time given a rat to kill in the presence of the kitten. The detailed procedure will be described in section IV.

Condition 3. Kittens raised in the same cage with rats. In this condition, new born kittens were kept in the same cage with different kinds of rats, until four months old. The detailed procedure of this part of the investigation will be described in section V.

Condition 4. Food-habit. We divided the kittens in this study into two groups, vegetarians and non-vegetarians. The

total number of kittens used in this investigation was fifty-nine. Of these, 30 were fed on beef, pork, milk and fish, mixed with cooked rice, while 29 were fed on milk, vegetables, and beans, mixed with cooked rice. We shall call the kittens fed on meat diet non-vegetarian group (N.V.), and those on non-meat diet, vegetarian group (V.). These two different food-habits were started as soon as the kittens were able to take food. Our purpose was to determine whether or not food-habit had anything to do with the kitten's rat-killing and rat-eating responses. The vegetarian and non-vegetarian kittens were about evenly distributed in each of the groups described in sections III, IV, and V. The results will be presented in section VII.

Condition 5. Hunger condition. Of 59 kittens, 30 were starved for 12 hours on the days when their response to the rat was to be tested. The other 29 were tested immediately after feeding. Our aim was to determine the effect of hunger conditions on the behavior of the kitten toward the rat. Again, the numbers of twelve-hours-starved kittens and immediately fed kittens were about equally distributed in each of the groups described in sections III, IV and V. The results will be presented in section VIII.

Condition 6. Training the cat to kill the rat. The details of this method will be described in section VI.

Condition 7. The effect of participating in and seeing other cats devouring the rat. This involves two questions:

1. Will the rat-killing action in the kitten, when it is allowed to see its mother in the act of devouring the rat, or when it is allowed to participate with its mother in devouring the rat, be developed more readily and earlier than when it is allowed merely to see its mother in the act of killing the rat without seeing or participating in devouring the prey?

2. Will seeing or participating in the act of devouring the rat increase the tendency on the part of the kitten to eat rats? At first we thought to test these questions by dividing the group of kittens, raised in the rat-killing environment (condition 2), into three sub-groups. (1) Those who would merely see their mothers kill rats (in this case, the rat was to be immediately taken away

from the mother who had killed it so that she had no chance to devour it; (2) those who would see their mothers in the act of both killing and eating the rat; and (3) those who were to be allowed to share the game with their mothers. In sub-groups (1) and (2) the mother and the rat were to be put outside of the kitten's cage during each test, while in sub-group (3) the mother and the rat both were to be put inside the kitten's cage. In the former case, the rat, though it could be seen, was not accessible to the kitten.

This was my original plan. But later on, when I found that this condition would be complicated with the vegetarian condition and that the results would not be comparable (as the vegetarian kittens were not allowed to eat any meat, they should also be kept from eating the rat killed by their mothers), this part of the research was not carried out. In the near future we shall conduct another independent experiment to test the effect of this condition. In this future experiment, all kittens should be non-vegetarians.

Condition 8. What kind of rat did the kitten prefer to kill? This was to determine whether or not the kitten in killing a rat had any preference as to species. Three kinds of rats, albino rats (A.), wild mice (W.), and dancing mice (M.), were used to test this problem. The details of testing this condition will be described in section III, while the results will be presented and discussed in section X.

Condition 9. Training the cat to fear the rat. This was designed to determine whether or not the cat could be made to fear the rat by the method of conditioned reflex. This will be described and discussed in section XIII.

The preliminary work of this study was done at Fuh Tan University, Shanghai, by two students, Mr. Tsung-Wen Chiang and Mr. China Hu, but the major part of the study was carried out by the writer himself at his own home at Shanghai, during March, 1924, to May, 1925, and during September, 1927, to September, 1928. While the results of the preliminary study by the two students are very similar to those of the major study reported below, the conditions of the experiments by the students

were not rigidly controlled, so that I decided not to incorporate them in this paper.

III. KITTENS RAISED IN ISOLATION

The experiment

1. *The kittens.* In this part of the study twenty kittens were used. They were born and kept during the period of experiment in the experimental room. They were taken from different litters.

2. *The condition of isolation.* When a mother cat was about to give birth to a litter of kittens, she was separated from other cats and kept alone in a wire cage (36 inches by 24 inches by 24 inches). As soon as the kittens were born, both the mother and the kittens were not allowed to see any rat or see another cat in the act of killing a rat. To prevent the possibility of seeing wild rats, the cage was covered with cloth at night, only allowing sufficient open space for ventilation.

As soon as the kittens were weaned, (generally at fourteen to eighteen days. Weaning could be hastened by teaching the kittens to drink cow's milk from a nursing bottle which was made after the same pattern as a baby's nursing bottle except for being much smaller in size; this artificial feeding was generally begun when the kittens were eight to ten days old), they were separated from one another, each being kept alone in a cage about two-thirds of the size of the cages in which adult cats were kept; the mother was immediately removed from the room so as not to allow her voice to be heard by the young. Now each young kitten living alone in a cage was not permitted to see any rat, or see or hear any adult cat killing rats; each cage also was covered with cloth at night.

3. *Food-habit.* Of the 20 kittens under observation, 10 were vegetarians and 10 non-vegetarians. From the time of birth till the end of the experiment, the vegetarian kittens were not allowed to touch or smell any meat. Even before weaning, their mothers were always taken from their cages during feeding hours so that the young had no chance to smell or touch the mother's food.

4. *Hunger condition.* Half of these kittens were tested for their response to the rat immediately after they were fed, while the other half were tested after they had been starved for twelve hours.

5. *The test.* When each kitten was from six to eight days old, the test for its response to the rat was begun. Both before and after weaning, the test was done in the kitten's own cage. If it was tested before weaning other kittens of the litter were removed temporarily from the cage until the test was finished.

The procedure of testing was thus:

Every four days, each kitten was presented with three rats (one albino, one wild rat, and one dancing mouse) in succession, and its responses to each of these were recorded. Each rat was kept with the kitten for thirty minutes. If after thirty minutes, the rat was not killed by the kitten, it was taken out and another rat was put into the cage. If this second rat was not killed in thirty minutes, it also was removed, and a third rat was presented to the kitten. The rats were always put into the cage in the following order: (1) albino rat, (2) wild rat, (3) dancing mouse. Of the three kinds of rats used throughout the investigation, the albino rat was the largest (about adult size), wild gray rat second (about the size of a one-month old albino rat), the dancing mouse the smallest. But if the kitten killed the first or second rat within thirty minutes, the other two or one rat were not presented until four days later, that is, until the next testing period. If the kitten killed one of three kinds of rats on a given testing day, it was presented only with the two other kinds of rats on the following test days. If it also killed one more kind, in the remaining tests only the third kind of rat was presented to it. This was continued until the kitten killed all three kinds of rats, or until it was about four months old (varying from 118 days to 121 days old) as the case may be. At the age of four months the test was discontinued regardless of whether the kitten had killed any rat. But if it had killed all three kinds of rat before it was four months old, the test was also discontinued immediately after the third kind of rat was killed.

Results

The results of the tests on the 20 kittens raised in solation are summarized in table 1. The effects of food-habit, hunger condition and age on the kitten's behavior towards the rat will be treated in sections VII, VIII and IX respectively. In the "age" column of table 1, each figure refers to the age in days at which the kitten first killed a rat irrespective of the kind of rat being

TABLE 1
(For explanatory notes see the text)

CAT NUMBER	SEX	F.H.	H.C.	AGE	D.	K.R.K.
1	♂	V.	0	51	0	M.
2	♀	N.V.	0			
3	♀	N.V.	12	82	d.	W.
4	♀	V.	12			
5	♀	V.	12	96	0	A.W.M.
6	♂	V.	0	84	0	A.W.M.
7	♀	N.V.	12	102	d.	A.W.M.
8	♂	V.	0			
9	♂	N.V.	12			
10	♀	V.	0			
11	♀	V.	12	120	0	M.W.
12	♂	N.V.	12			
13	♀	N.V.	0	111	0	W.M.
14	♀	N.V.	0			
15	♂	V.	12	43	0	M.
16	♂	V.	12			
17	♀	V.	0			
18	♀	N.V.	12			
19	♀	N.V.	0			
20	♂	N.V.	0	56	d.	M.

killed. Those not filled with figures in the "age" column indicate that these kittens did not kill any rat before the age of four months. Similarly in the "D." column, 'd' indicates that the kitten devoured the rat, while those not filled with 'd', indicate these kittens did not eat any rat, regardless of whether or not they had killed any rat. The "K.R.K." column, indicates the kinds of rat each kitten killed during the tests (M., dancing mouse; W., wild rat; A., albino rat). In section X, we shall discuss the

kinds of rat the kittens had killed. Column "F.H." refers to "food habit" of the kittens (V., vegetarians; N.V., non-vegetarians). Column "H.C." refers to "Hunger Conditions" (0, tested immediately after feeding, 12 tested 12 hours after feeding).

To facilitate reading this and subsequent tables, we give two examples. Kitten 1, male (σ), vegetarian (V.), always tested immediately after feeding (0), first killed a rat at 51 days old, but did not devour the rat (0); it killed a dancing mouse (M.) only. Kitten 3, female (φ), non-vegetarian (N.V.), tested 12 hours after feeding (12), first killed a rat at the age of 82 days, and devoured it (d.); it only killed wild rat (W.). Kitten 5, killed three kinds of rats, so in the "K.R.K." column, it is indicated by "M.", "A." and "W."

It will be noted that of the 20 kittens used in this part of the investigation only 9 killed rats without previous experience of killing rats, or of seeing or hearing the killing of rats by other cats. If one insists that this is evidence for the existence of the rat-killing instinct in the cat, one should also account for the fact that the other 11 kittens failed completely to kill any rat while they were from one week to four months old. Watson says that Berry's negative results were due to the fact that the instinct had waned through disuse. But our own kittens were given every chance to use the instinct from the very early days of their life. At any rate, waning can not explain the failure of these 11 kittens to kill rats. McDougall suggested that the odor of the wild rat might be the original stimulus for the cat's instinct. But these 11 kittens were given a wild rat for thirty minutes every four days, but the "original stimulus" simply could not stimulate. Berry, Yerkes, and Rogers think that the wildness (or running) of the gray rat might be responsible for the attack by the kitten. But these 11 kittens were given very tame as well as very wild rats, but they simply did not work.

Many psychologists believe that an instinct is universal in a species. But here the criterion of universality breaks down completely, since 11 kittens out of 20, or 55 per cent, did not seem to possess the rat-killing instinct.

Well, is the rat-killing instinct proven or disproven by this ex-

periment? Neither! *The results of our experiment merely show that both the concepts of instinct and habit are inadequate for behavior description.* We shall discuss this more fully in the last section of this report.

TABLE 2
(For explanatory notes see the text)

CAT NUMBER	SEX	F.H.	H.C.	K.R.S.K.	AGE	D.	K.R.S.K.
21	♀	V.	12	W.	41	0	M.W.
22	♀	V.	12	W.	0		
23	♂	V.	0	W.	51	0	W.M.
24	♂	N.V.	12	W.	62	d.	W.M.
25	♂	N.V.	12	W.	0		
26	♂	N.V.	0	W.	78	d.	W.M.
27	♂	N.V.	0	W.	83	d.	W.
28	♂	V.	0	M.	0		
29	♀	V.	0	M.	108	d.	M.W.
30	♀	V.	12	M.	94	0	A.M.W.
31	♂	V.	12	M.	46	0	M.
32	♂	N.V.	0	M.	63	0	W.M.
33	♀	N.V.	12	M.	51	0	M.
34	♀	N.V.	12	M.	55	0	M.
35	♀	N.V.	0	A.	67	d.	A.W.M.
36	♀	N.V.	0	A.	93	d.	A.W.M.
37	♀	N.V.	12	A.	69	d.	A.W.M.
38	♂	N.V.	12	A.	63	d.	A.W.M.
39	♂	V.	12	A.	74	0	A.W.M.
40	♂	V.	0	A.	101	0	A.W.M.
41	♂	V.	0	A.	84	d.	A.W.M.

IV. KITTENS RAISED IN THE RAT-KILLING ENVIRONMENT

The experiment

1. *The kittens.* There were 21 kittens used in this part of the research. The food-habit, hunger conditions during tests and the procedure of test for these kittens were exactly the same as those used in the former group, namely, those kittens raised in isolation, except that the kittens of the present group every four days saw their mothers kill a rat. This is what we mean by the statement "Kittens raised in the rat-killing environment."

2. *The rat-killing environment.* We divided these twenty-one kittens into three groups, each group having seven kittens.

Every four days, one group were to see their mothers kill wild rats; one group saw their mothers kill albino rats; and the third group saw their mothers kill dancing mice. The group which saw their mothers kill wild rats were never allowed to see the action of killing other kinds of rats. The same is true of the other two groups which were allowed to see the killing of either dancing mice only or albino rats only. But in every test, each of these twenty-one cats was presented with all three kinds of rats in succession as was done with the kittens raised in isolation. When the kittens were from six to eight days old, their mothers were taken from the cage and given a rat of the kind prescribed for a given group to kill outside the cage. The action of killing and any sound from the mother or rats could be distinctly heard or seen (not of course, until the kittens had gained their vision) by the kittens inside the cage. As soon as a rat was killed, it was taken away from the cat; in no case was the mother allowed to devour the rat. Immediately after this each kitten was taken into another familiar cage where it was tested for its responses to the three kinds of rats; the test was done in the same way as the test on the kittens raised in isolation. The same routine—seeing its mother kill a rat, then being tested for its own responses to rats—was repeated every four days until the kitten had killed all three kinds of rats or until it was four month sold.

Results

The results of the test on these twenty-one kittens are summarized in table 2. The column "K.R.S.K." indicates the kind of rat which each kitten saw its mother kill. Thus kittens 21 to 27 saw their mothers kill wild rats only. Nos. 28 to 34 saw their mothers kill dancing mice only; and Nos. 35 to 41 saw their mothers kill albino rats only.

While we shall discuss the influence of food-habit, hunger condition and the age factor on the kitten's behavior in sections VII, VIII and IX, we must point out here two important facts: (1) We have found that of 20 kittens raised in isolation only 9, or 45 per cent killed one or more kinds of rats before they were four months old (see the "age" column of table 1). Quite in

contrast to this, we find that of 21 kittens raised in the rat-killing environment 18, or more than 85 per cent killed one or more kinds of rats before they were four months old (see the "age" column of table 2). (2) Each of the eighteen kittens might kill one or more than one kind of rat, but it always killed the kind of rat which it saw its mother kill (see the "K.R.S.K." column of table 2). These two facts both point to the importance of the mother's influence on the kitten's behavior. Furthermore, the average age for the first act of rat-killing seems much earlier for kittens raised in the rat-killing environment than for those raised in isolation. We shall discuss age as a factor in determining rat-killing in section IX.

V. KITTENS RAISED IN SAME CAGE WITH RATS

The experiment

1. *The kittens.* In this part of the investigation, 18 kittens were employed. The food-habit, hunger-condition and tests were exactly the same as in the other two groups, namely, those raised in isolation and those raised in the rat-killing environment. But in the present group, the living condition is radically different from that in the other two groups.

2. *Living with rats.* When the kittens were from six to eight days old, we commenced to make them stay with rats during most of the day, their mothers being kept away when the rats were in the kittens' cages. After six to eight days and before weaning, the mothers were allowed to stay with their young in day time for not more than three to four hours per day, but at night, the rats were taken out, and the mothers were returned to their young until next morning. Each kitten was kept in a separate cage together with one rat. This was uniformly done from six to eight days to four months old. Thus, even before weaning, each kitten spent more time (except at night) with its rat companion than with its mother and brothers and sisters. After weaning the kitten had no other companions than the rat; it really lived in isolation so far as companionship of its own kind is concerned. We divided the eighteen kittens into three groups: (1) Six lived with dancing

mice only (always one rat to a kitten in a separate cage); (2) six with wild rats only; and (3) six with albino rats only.

As in the experiments reported in the two previous sections, every four days we introduced in succession three strange rats (dancing mouse, wild rat and albino rat) into the cage of each kitten to test the latter's response to them. The familiar rat that was living with the kitten was taken out during tests.

TABLE 3
(For explanatory notes see the text)

CAT NUMBER	SEX	K.R.L.	F.H.	H.C.	AGE	D.	K.R.K.
42	♀	W.	V.	0			
43	♀	W.	V.	12			
44	♀	W.	N.V.	0			
45	♀	W.	N.V.	0			
46	♂	W.	N.V.	12			
47	♀	W.	N.V.	12			
48	♀	M.	V.	12			
49	♂	M.	V.	12			
50	♂	M.	V.	0			
51	♀	M.	N.V.	12			
52	♀	M.	N.V.	0			
53	♂	M.	N.V.	12			
54	♂	A.	V.	0	72	0	W.
55	♂	A.	V.	0			
56	♀	A.	V.	12	81	d.	W.
57	♀	A.	N.V.	0	95	d.	W.
58	♀	A.	N.V.	0			
59	♂	A.	N.V.	12			

Results

The results of this part of the research are summarized in table 3. The column "K.R.L." indicates the kind of rat with which the kittens were made to live.

It will be noted that with the exception of kittens 54, 56, and 57, none of the kittens ever killed a single rat. Even these three exceptional kittens did not kill the kind of rat with which they were kept in the same cage. (See table 3, column "K.R.K.")

VI. TRAINING THE KITTEN TO KILL RATS

The experiment

1. *The kittens.* Having found that 11 kittens raised in isolation and 15 raised in the same cage with rats had failed to kill any rat even up to four months old, we began to introduce additional stimuli to train these 26 kittens to kill rats. In this part of the investigation, we did not use those three kittens raised in the rat-killing environment which had also failed up to the age of four months to kill any rat for the reason that the additional stimuli we adopted here had already been used throughout all the tests for the kittens raised in the rat-killing environment but had failed to function in these three particular kittens.

2. *The tests.* The tests were essentially the same as those used in other parts of the investigation except that as a training method we here introduced additional stimuli in such a way as to reënforce and localize the original stimulating object (rat) which we desired to call forth a positive response (killing) in the kitten, but which had previously failed to do so. The additional stimuli we employed were the actions of capturing and killing rats by adult cats. In fact the procedure in this part of the experiment was identically the same as that used for testing the responses of the kittens raised in the rat-killing environment; the chief difference lies in the fact that in the latter case, such additional stimuli were introduced before their eyes were open, while they were used here only after the stimulating object originally used failed to function, that is, after the kittens up to the age of four months had failed to kill any rat. But there is one more significant difference: of the kittens raised in the rat-killing environment, each kitten was allowed to see its mother kill one kind of rat (albino, or wild, or dancing mouse) only, while kittens in this part of the investigation saw adult cats kill all three kinds of rat.

Each of these 26 kittens was tested every four days, from the age of 118 to 122 days to approximately six months, or to any age before six months at which it had killed all three kinds of rats. Each test was given immediately after the kitten had seen the action of rat-killing by an adult cat outside of its cage.

Results

The results of introducing reënforcing stimuli to train these 26 kittens in rat-killing are summarized in table 4.

In this table we find two striking facts: (1) Of the 11 kittens from the group raised in isolation, 9 became rat-killers, appar-

TABLE 4
(For explanatory notes see the text)

CAT NUMBER	SEX	F.H.	R.G.	AGE	D.	K.R.K.
2	♀	N.V.	0	126	d.	A.W.M.
4	♀	V.	12	131	0	W.M.
8	♂	V.	0	140	d.	A.W.M.
9	♂	N.V.	12	147	0	A.W.M.
10	♀	V.	0	161	0	W.
12	♂	N.V.	12	0		
14	♀	N.V.	0	0		
16	♂	V.	12	173	0	A.W.M.
17	♀	V.	0	142	0	A.W.M.
18	♀	N.V.	12	153	0	W.M.
19	♀	N.V.	0	128	0	A.W.M.
42	♀	V.	0			
43	♀	V.	12			
44	♀	V.	0			
45	♀	N.V.	0			
46	♂	N.V.	12			
47	♀	N.V.	12			
48	♀	V.	12			
49	♂	V.	12			
50	♂	V.	0			
51	♀	N.V.	12			
52	♀	N.V.	0			
53	♂	N.V.	12			
55	♂	V.	0			
58	♀	N.V.	0	154	d.	W.
59	♂	N.V.	12			

ently due to the effects of reënforcement and localization of the stimulation. (2) On the other hand, of 15 kittens from the group raised in the same cage with rats, we succeeded in training only one to kill a wild rat. This clearly indicates that it is extremely difficult to make a cat kill a rat if it has grown up with rats in the same cage since it was very young.

Another interesting fact to be noted is that three kittens (nos. 2, 8, and 58) were rat-eaters, although they had been prevented from seeing the rat-eating action in adult cats. Several kittens raised in the rat-killing environment also ate rats without previously seeing their mothers perform the same act. Thus, it seems that rat-eating behavior may also be developed without any reënforcement from additional stimuli. But it is highly possible that with reënforcement of stimulus, the number of rat-eaters may be increased. Further investigation will decide this matter.

VII. RELATION BETWEEN FOOD-HABIT AND RAT-KILLING AND RAT-EATING

Will the difference in food-habit in kittens make any difference in the rat-killing and rat-eating responses? Will a vegetarian cat

TABLE 5

FOOD HABIT	TOTAL NUMBER OF CATS	NUMBER OF RAT-KILLERS	PER CENT	NUMBER OF RAT-EATERS	PER CENT
V.	29	20	50	4	20
N.V.	30	20	50	13	65
Total.....	59	40		17	

kill any rat at all? Will it eat any rat at all? Or will vegetarianism tend to reduce the cases of rat-killing and rat-eating? It will be remembered that in each of the above experiments, the kittens were divided into two groups, the vegetarian and the non-vegetarian. Table 5 derived from tables 1, 2, 3, and 4 gives the numbers and percentages of rat-killers and rat-eaters for the vegetarians (V.) and the non-vegetarians (N.V.). It will be noted that of the 59 kittens, 40 were rat-killers, but only 17 were rat-eaters. Of the 40 rat-killers, 20, or 50 per cent were vegetarians while the other 20 or 50 per cent were non-vegetarians. On the other hand, of the 20 vegetarian rat-killers only 4 or 20 per cent were rat-eaters, while 13 or 65 per cent of the non-vegetarian rat-killers were rat-eaters.

It seems, then, that vegetarianism tends greatly to reduce the number of rat-eating kittens whereas it has no specific effect on

the rat-killing behavior. But we must here mention the fact that, due to the limited number of rats in our possession, we were compelled to let each kitten kill not more than one rat of each kind. Should the kittens be given more rats to kill, the chances are that the number of rat-eaters might be increased. But whether or not such an increase will alter the relative percentages of the two groups we are not prepared to say. Of course, from the present result, one is rather inclined to expect that possible increase would be in favor of the non-vegetarian group rather than of the vegetarian group. Attention is also called to the fact that most of our vegetarian kittens refused to take any meat after they were from three to four months old.

At any rate, food-habit seems to be an important factor in the rat-eating behavior of the cat.

TABLE 6

H.C.	TOTAL NUMBER OF CATS	NUMBER OF RAT-KILLERS	PER CENT	NUMBER OF RAT-EATERS	PER CENT
0	29	21	52.5	11	52.3
12	30	19	47.5	6	31.6
Total.....	59	40		17	

VIII. RELATION BETWEEN HUNGER CONDITION AND RAT-KILLING AND RAT-EATING RESPONSES

It will be recalled that throughout the investigation, the kittens were divided into two groups of different hunger conditions; one group was always tested immediately after feeding, the other twelve hours after feeding. The effects of hunger condition on rat-killing and rat-eating responses are shown in table 6. This table was also derived from tables 1, 2, 3 and 4. It is thus seen that difference in the degree of hunger makes little difference so far as rat-killing and rat-eating responses of the kitten are concerned. In fact, the number and percentage of rat-eaters are both higher for the group tested immediately after feeding (0) than for the group tested twelve hours after feeding (12). Of course, it would be absurd to state that the immediately fed kittens are more likely to eat rats than the more hungry ones. We can

only say that hunger condition has very little effect on rat-killing and rat-eating responses. Here again, it must be remembered that the kitten was allowed to kill or eat not more than one rat of each kind.

IX. THE AGE FACTOR IN RAT-KILLING BEHAVIOR

Our next question is to find out (1) whether the conditions of life of the kittens had any influence on the age at which the first act of rat-killing was observed, and (2) whether or not age is a factor in determining which kind of rat the kittens would kill.

TABLE 7
(See the text)

GROUP	EARLIEST AGE	OLDEST AGE	AVERAGE AGE
Raised in isolation.....	43	120	82.7
Raised in rat-killing environment.....	41	108	71.2

TABLE 8

KIND OF RAT KILLED	EARLIEST AGE	AVERAGE AGE
A.	88	109.78
M.	43	69.03
W.	41	78.17

Table 7 gives the average ages as well as the earliest and the latest at which the behavior of rat-killing in the two groups of kittens, those raised in isolation and those raised in the rat-killing environment, was first observed. It will be seen that the average age for the first act of rat-killing for the kittens raised in the rat-killing environment is about 11 days earlier than that for the kittens raised in isolation. It clearly suggests that the rat-killing action of the mother not only induces more young to perform the same action but also makes such behavior of the young appear earlier than when they were raised in isolation.

Table 8 derived from the original records of our investigation gives the earliest and the average age for the first appearance of rat-killing behavior of the kittens for each kind of rat. The

figures show clearly that it requires a much older kitten for the first attempt to kill an albino rat than the age required for the first killing of either wild rat or dancing mouse. On the average, the age for killing wild rat is also greater than that for killing dancing mouse. Such age differences required for killing different kinds of rat are apparently due to the difference in size among the three kinds of rat, albino being the largest, dancing mouse the smallest. It may be safe to conclude that no kitten would attempt to kill (not to say succeed in killing) an albino rat before it is 3-4 months old while the killing of wild rat or dancing mouse may appear as early as a little over 40 days of age.

TABLE 9

KIND OF RAT KILLED	NUMBER OF CATS	PER CENT
Wild Rat.....	7	17.5
Mice.....	6	15.0
Albino rat.....	0	0
Wild rat and mice.....	10	25.0
Wild and albino rat.....	0	0
Wild mice and albino.....	17	42.5
Total.....	40	

X. WHICH KIND OF RAT DOES THE KITTEN PREFER TO KILL?

Does the kitten kill rats indiscriminately or does it prefer one kind of rat to another? If it has such a preference, what is the cause? Table 9, derived from tables 1, 2, 3, and 4, partly answers these questions. The table gives (1) the number and percentage of kittens who killed one kind of rat only (wild rat only, or dancing mouse only, or albino rat only), (2) the number and percentage of those kittens who killed two kinds of rats only (wild and albino only, or wild and mice only, or albino and mice only), and (3) the number and percentage of those kittens who killed all three kinds of rats.

In this table two facts should be noted: (1) In every case, the kittens which killed albino rats also killed the other two kinds of rats: (2) the number of kittens (17 or 42.5 per cent out of 40 rat-killing kittens) who killed all three kinds of rats is much

greater than the number of kittens who killed wild rats only (7 or 17.5 per cent or who killed dancing mice only (6 or 15 per cent).

From these facts and the facts brought out in sections III, IV, V, and IX, we may conclude that (1) kittens have not the so-called "innate preference" for killing certain species of rats; (2) that they will usually kill the kind of rat which they see their mothers kill; (3) that they will not kill the kind of rats with which they are brought up in the same cage; (4) that if the kittens have not reached sufficient age, they usually do not kill rats of larger size (this is, of course, due to the fact that young kittens have not sufficient size and strength to handle larger rats); and, (5) that kittens who kill large sized rats will also kill smaller rats of different species. (1), (2), and (3) all point to the importance of environmental influence, while (4) and (5) indicate the importance of the age and size of the cat as well as the size of the rat as determining factor. However, we do not wish to insist that environmental influence is the all important factor in this connection. In the group of kittens raised in isolation we found that while it is true that no kitten which killed albino rats would not kill the other two kinds of rats, there were kittens which killed wild rats only, or dancing mice only, or wild rats and dancing mice only. While we feel justified in concluding that kittens *generally* have not the so-called innate preference as to the species of rat they will kill, we are not prepared to account for certain particular kittens which killed one kind of rat rather than another. Whether it is merely a matter of chance or a result of some other factors which have not been discovered in our investigation we cannot say with certainty.

XI. TYPES OF RESPONSES

In the previous sections we dealt with only the rat-killing behavior of the kittens. But the kittens' responses to the rat are a very complex affair. The rat-killing behavior is merely one of the many kinds of responses of the kittens which the stimulating object (rat) can call forth. For convenience sake we shall classify the kitten's responses to the rat into the following types: type 1,

positive; type 2, negative; type 3, oriented; type 4, tolerant; type 5, playful; type 6, hostile.

Type 1. Positive. In this type the kitten's responses consisted in a series of movements to which we have given a common name "rat-killing behavior."

Type 2. Negative. By negative response we refer to the fact that the kitten did not respond to the presence of the rat. In this type the kitten not only showed no positive response to the rat, but also was not oriented toward the rat, even when sometimes the rat was making movements or sounds.

Type 3. Oriented. Here the kitten was usually so oriented that its head was turned toward the rat with eyes fixed upon it, but no further response to the rat was found during the test period. If orientation was followed by some other response, that is, if after orientation toward the rat, the kitten proceeded to do something with the rat, then the type of response does not belong here; we will not call it orientation, but some other type of response according to its nature.

Type 4. Tolerant. When kittens displayed this type of response, they allowed the rat to perch on its back, to smell at its nose and to do other similar acts. The kitten not only did not attempt to injure the rat, but also made no hostile or even repulsing response to it.

Type 5. Playful. Here we refer to the kind of response which is almost identical with the kitten's play with its brothers or sisters or with a moving object. It consists of running after the rat, catching it, holding it with its paws, throwing it gently into the air, sham biting, giving it up and running away from it for a moment, and then rechasing it, playing with it again, trying to hide from it, patting or turning the rat with one paw etc., and finally giving the rat up without any injury; the kitten turning away from the rat, lying down, making no further response to it, or else responding to some other object than the rat. This type is distinguished from type 1 in that in the latter the attempt at killing or actually killing the rat was observed, while in the former the kitten merely played with the rat and then left it alone without any injury done to it. Of course, play activities were also

observed in type 1, but such activities were usually complicated or followed by killing.

Type 6. Hostile. In this type when the kitten saw a strange rat, it began to growl, hind legs standing straight, body being so bent that the back was lifted up, hair erected, eyes dilated and gazing at the rat. Sometimes trembling was also observed. When the rat came near the kitten, the latter began to hiss and spit, lifting its paw to strike the rat away. All such behavior characteristics are identical with those displayed by the cat in fighting with a strange cat or a dog. Here again, it must be noted that this type of response may also be complicated or followed by the action of killing or attempt at killing the rat. In such cases the behavior is classified as type 1.

The responses of the three groups of 59 kittens to the rats during each test were classified according to these six types and are presented in table 10.

Some explanatory notes for this table are necessary. (1) Each digit designates one type of response according to the above mentioned method of classification. (2) A. = albino rat, W. = wild rat, and M. = dancing mouse. (3) Each kitten in response to one kind of rat had more than one type. In one test its behavior was of a certain type, in another it might change to some other type. For example kitten 1's response to the albino rat at first was of type 2, but later on was replaced by type 3, then by type 6, and finally, by type 2. In the table, the different types of responses are arranged according to the chronological order of their appearance during the test periods, i.e., from six to eight days old to four months old. (4) If the same type of response appeared more than once consecutively in different test periods, we only took the first appearance of the type; reappearances of the same type were not included in the table. (5) The first digit in each column is italicized to designate the type of response which was observed before the kittens gained their sight.

It will be noted that kittens before their eyes were open, had only either type 2, or type 4 or type 6. In the case of kittens without vision type 4 refers to those cases in which the kitten was tolerant of the rat's smelling and touching or even treading

on its body, while type 6 consists of only hissing and spitting when the rat smelled at, touched, or trod on the kitten.

In reading the table, several questions suggest themselves: (1) What is the relation between rat-killing response (type 1) and other types of response? (2) Does one kind of rat tend to call forth certain type or types of response more often than certain

TABLE 10

KITTENS RAISED IN ISOLATION				KITTENS RAISED IN THE RAT-KILLING ENVIRONMENT				KITTENS RAISED IN THE SAME CAGE WITH RATS			
Kitten	Kind of rat			Kitten	Kind of rat			Kitten	Kind of rat		
	A.	W.	M.		A.	W.	M.		A.	W.	M.
1	4,3,6,2	2,3,6,2	2,3,5,6,1	21	2,3,5	2,3,6,1	2,6,5,1	42	4,3,2	6,4,2	6,4,2,3
2	2,3,4	2,3,4	2,3,4	22	2,2	2,3,2	2,3,4	43	2,4,2	6,4,5	2,5,4
3	2,3,4,2	2,3,6,1	2,2	23	2,2	2,3,4,1	2,6,3,1	44	2,5,2	6,5,4	2,5,4
4	2,2	2,3,2	2,2,4	24	2,3,4	2,2,1	2,5,1	45	2,3,4	4,4	4,4
5	2,3,5,1	2,3,5,1	2,3,5,1	25	2,4,2	2,2,4	4,2	46	2,3,2,4	2,4	3,4
6	6,6,1	2,6,1	6,6,1	26	4,4	2,3,1	2,3,5,1	47	2,6,2	4,3,5	2,4,2
7	6,6,1	2,3,6,1	6,3,6,1	27	2,3,4	2,4,2	2,6,1	48	4,6	2,3,4	2,4
8	2,3,4	2,3,4	2,4	28	4,6,2	4,3,4	2,6,3	49	2,4,5	2,5,4	4,3,2
9	4,2,5,4	2,4,5	2,3,5	29	2,4,2	2,5,1	6,4,1	50	2,4	2,4	4,4
10	6,3,2	6,4,2	4,2	30	2,6,1	4,3,1	2,5,1	51	4,4	2,4	2,4
11	2,3,2	2,3,5,1	2,3,5,1	31	2,6,2	2,2	2,5,1	52	6,6,3	2,3,2	2,3,4
12	6,3,2	2,2,5	2,3,5	32	2,6,2	2,5,1	2,4,1	53	6,6	2,6	2,6
13	2,3,2	2,2,6,1	2,3,5,1	33	2,2,3,4	2,2,3	2,6,1	54	2,6,2	2,6,5,1	2,4,2
14	2,4,5	6,2,4	2,3,4,2	34	2,5	4,6	2,6,1	55	2,6,2	2,4	2,3,4
15	2,3,6	4,4,5	6,2,5,1	35	6,6,1	6,6,1	6,6,1	56	2,6,5	2,6,1	2,4,2
16	2,4,2	6,3,2	6,4,5	36	6,2,1	6,2,1	6,5,1	57	2,6,4	2,6,1	2,3,2
17	2,6,2	2,3,5	2,3,5,2	37	6,3,6,1	2,3,6,1	2,3,6,1	58	2,6,4	2,5,4	2,3,4
18	6,6,5	2,5,4	2,3,5,2	38	2,4,1	6,4,1	2,6,5,1	59	2,6,4	2,3,4	2,2,4
19	2,4,3,2	2,6,5	2,3,0,5	39	6,6,1	6,6,1	2,2,1				
20	2,3,4	2,3,4	2,3,6,1	40	6,3,1	6,4,1	2,2,1				
				41	6,6,5,1	6,6,5,1	2,2,6,1				

other types? (3) Does the condition of life of the kittens have any influence on the types of their responses to the rat? To answer these questions tables 11, 12, and 13 are constructed from table 10.

1. Relation between type 1 and other types of response

Table 11 gives the total number of cases and percentage of each of the six types of response for the rat-killers (i.e., cats which

displayed type 1 response) and non-rat-killers (i.e., cats which did not display type 1 response to any kind of rat). It is interesting to note that with the exception only of type 6, the percentages of all the other types are larger for the non-rat-killers than for the rat-killers. This suggests that type 6 (hostile) is more closely related than other types to the rat-killing behavior. From the standpoint of prediction, when one finds a kitten displaying hostile responses to the rat, one is safer in expecting the kitten later to kill the rat than in expecting it to do otherwise. Attention is also called to the fact that the percentage of type 6 is also larger for the kittens raised in the rat-killing environment than that for those raised in isolation and for those raised in the same cage with rats (see table 13). It will be remembered that most of the

TABLE II

RAT-KILLERS			NON-RAT-KILLERS			TOTAL
Type	Total number of cases	Per cent	Type	Total number of cases	Per cent	
1	60	100	1	0		60
2	8	13.1	2	53	86.9	61
3	21	30.4	3	48	69.6	69
4	6	8.2	4	67	91.8	73
5	20	43.7	5	27	56.3	47
6	32	58.7	6	23	41.3	55

kittens raised in the rat-killing environment were rat-killers. Another striking fact to be noted is that types 2 and 4 appear to be rather dominant in the non-rat-killers. Of 61 cases of type 2, 53 cases or 86.9 per cent belong to the non-rat-killer group, whereas the rat-killers had only 8 cases or 13.1 per cent. Similarly, of 73 cases of type 4, 67 cases or 91.8 per cent belong to the non-rat-killer group, whereas the rat-killers had only 6 cases or 8.2 per cent. From these data, one can predict that when a young kitten first displays type 2 or type 4 response to the rat, other conditions being equal, the chance that the kitten will later kill the rat is less than 10 per cent. But, of course, such a prediction is by no means reliable since the number of kittens used in our investigation is not large enough. And we are here

interested more in the extremely high negative relationship between responses of type 2 and type 4 and the rat-killing behavior than in the accuracy of prediction which might be obtained by using many more kittens under the same conditions.

2. Relation between the kind of rat and the types of response of the kitten

Table 12 gives the number of cases and percentages of each type of the kittens' responses to the albino rat (A.), the wild rat (W.), and the dancing mouse (M.). It will be seen that both the dancing mouse and the wild rat tended to call forth type 1 response much more often than the albino rat would do. That is

TABLE 12

KIND OF RAT	TYPES OF KITTENS' RESPONSES											
	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6	
	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent
A.	11	18.3	27	44.3	22	31.9	24	32.9	10	21.4	24	43.7
W.	23	38.4	16	26.2	23	33.3	26	35.6	17	36.0	16	29.1
M.	26	43.3	18	29.5	24	34.8	23	31.5	20	42.6	15	27.2
Total.....	60		61		69		73		47		55	

to say, the possibility that the kitten will kill a wild rat or dancing mouse is more than twice as large as that it will kill an albino rat. The percentage of type 1 response called forth by dancing mice is also slightly larger than that called forth by wild rats. In section X we have suggested that the size of the rat has a great deal to do with the rat-killing behavior of the kitten. We have also pointed out that young kittens, due to their smaller size, would not attack the albino rats as readily as they would the other two kinds of rats. The table also shows that the albino rats tend to induce types 2 and 6 more often than the two other kinds of rats do. On the other hand, the percentage of type 5 is much larger in the case of wild rats and dancing mice than in the case of albino rats. All these facts lead to the suggestion that larger sized rats are more likely than the smaller ones to call

forth hostile and negative responses from kittens, while the kittens' killing and playful responses are more readily called out by smaller rats than by larger ones.

3. Relation between types of response and life conditions of the kittens

In table 13 the number of cases and percentage of each type of response are grouped together according to the life conditions of the kittens, that is, kittens raised in isolation, those raised in the rat-killing environment and those raised in the same cage with rats. Beside the striking fact that 66.6 per cent of type 1 response belong to the kittens raised in the rat-killing environment and only 5 per cent of it belong to those raised in the same cage with

TABLE 13

TYPE OF RESPONSE	RAISED IN ISOLATION		RAISED IN RAT-KILLING ENVIRONMENT		RAISED WITH RATS		TOTAL
	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	
1	17	28.4	40	66.6	3	5.0	60
2	25	41.0	20	32.8	16	26.2	61
3	36	52.2	19	27.5	14	20.3	69
4	21	28.8	16	21.9	36	49.3	73
5	23	48.9	13	27.7	11	23.4	47
6	16	29.1	24	43.7	15	27.2	55

rats, the table shows that (1) types 2, 3, and 5 for the kittens raised in isolation, (2) type 6 for those raised in the rat-killing environment and (3) type 4 for those raised in the same cage with rats, have the largest percentages. The fact that the rat-killers showed most hostile attitude towards the rat even before their first act of rat-killing was observed, and that the kittens raised in same cage with rats are most tolerant of strange rats, need not cause any surprise. But we are not as yet able to explain why kittens raised in isolation should have more cases of types 2, 3, and 5 than the other kittens. Whether it is merely a matter of chance or has some important factor unknown to us we are not prepared to say.

XII. THE BEHAVIOR OF KITTENS TOWARD THE RAT WITH WHICH
THEY WERE RAISED IN THE SAME CAGE

In the foregoing section we dealt with the types of response of the kittens to the strange rat. In the present section we shall describe the types of responses of the kittens towards the rats with which they were raised in the same cage. We shall classify such responses (as they were observed in our investigation) into the following types: type 1, negative; type 2, tolerant; type 3, playful; type 4, protective; type 5, attaching.

Here type 1 corresponds to type 2 in the foregoing section, type 2 to type 4, and type 3 to type 5. Only types 4 and 5 need some explanation. By protective responses we mean those acts which are similar to the actions of a mother cat in the protection of her young. A mother cat fights off a stranger be it a man, a dog or another cat who is approaching or attempting to attack her young. The details of the behavior need not be described here since every one is familiar with them. We found that three of our kittens when they were from five to six months old manifested such protective responses toward the rats living in the same cage with the kittens.

By attachment is meant those seeking and restless movements of the kitten when its cage-mate—the rat—was absent from the cage. After the cage-mate was taken from the cage, the kitten began to mew continuously, became restless and searched from corner to corner until the rat was returned to the cage. Such responses are often observed in a mother cat in seeking her young when they are separated. Young kittens when separated from other members of a litter also manifest such responses.

Protective responses and responses of attachment as described above are really what the traditional psychologists call manifestations of "love." Indeed, if cats have an instinct of love, certain of my kittens have "shown" it in their response to rats.

In considering the types of response of the kittens to their cage-mates—rats—one must not forget the fact that these kittens not only did not have positive responses but also never manifested any hostile behavior.

The types of response each of the 18 kittens displayed are given in table 14. Table 15 gives the total number of cases and percentages of each type of response found in all the 18 kittens. It will be seen that types 2 and 3, were more often observed in these kittens than types 1, 4, and 5, while type 5 is more fre-

TABLE 14

	KITTEN NUMBER																	
	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Kind of rat..	W.	W.	W.	W.	W.	W.	M.	M.	M.	M.	M.	M.	A.	A.	A.	A.	A.	A.
Type of response.....	2	3	3,5	3,4	3,5	1	2	2,3	2,3	1	2	2,3	2,5	3,5	2,3	2,3	4,5	3,4,5

TABLE 15

	TYPE OF RESPONSES				
	1	2	3	4	5
Total cases.....	2	9	11	3	6
Per cent.....	6.4	29	35.5	9.7	19.4

TABLE 16

KIND OF RAT	TYPES OF KITTENS' RESPONSES									
	Type 1		Type 2		Type 3		Type 4		Type 5	
	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent	Total cases	Per cent
A.	0	0	3	33.3	4	36.3	2	66.6	4	66.6
W.	1	50	1	11.1	4	36.3	1	33.3	2	33.3
M.	1	50	5	55.6	3	27.3	0		0	
Total.....	2		9		11		3		6	

quent than types 1 and 4. Table 16 gives the total cases and percentages of each type according to the kind of rat: albino rat, wild rat or dancing mouse. It will be noted that most of type 5 responses of the kittens were called forth by albino rats (4 cases). Wild rats called out only two of such responses and dancing mice none.

XIII. TRAINING CATS TO FEAR THE RAT

The purpose of this part of the study was to make the cat run away from the rat by the method of conditioning.

The experiment

The method of training is as follows:

A cat (the cats used in this experiment were all adults and rat-killers) was put into chamber one of a wooden apparatus, 18

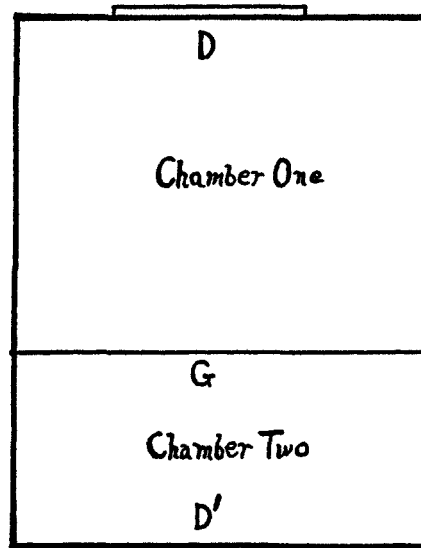


FIG. 1. CAGE FOR TRAINING CATS TO FEAR RATS

Chamber One is 26 by 24 inches; Chamber Two is 26 by 12 inches. A glass partition, *G*, separates the chambers. Door *D* is 10 inches wide; door *D'*, 4 inches wide. The height of the cage is 18 inches. Door *D* was opened as soon as the electric shock was given the cat.

inches high (see its ground plan in figure 1. The top of the apparatus was always covered with wire netting). Then a rat was introduced into chamber two through door *D'* (the two chambers are separated by a piece of glass *G* in the figure). As soon as the cat saw the rat, it received an electric shock. The shock was strong enough to make the cat jump, run wildly and sometimes mew, but not so strong as to injure its tissues. The shock was

continued until the cat got out through door *D*. Half an hour later the cat was put into chamber one of a cage, the ground construction and dimensions of which were identically the same as those of the apparatus shown in figure 1 except that (1) all the walls and the partition of the two chambers were made of wire netting instead of wood and glass, and that (2) the height of the cage was 24 inches instead of 18 inches. Then a rat was put into chamber two. The behavior of the cat towards the rat in the cage was observed for fifteen minutes. No shock was given to the cat in the cage chamber throughout the test period. (The writer believes that as far as the effects of stimulus are concerned, the cage condition is totally different from that of the apparatus, though the ground construction and dimensions of the two are the same.)

Ten cats were used in this experiment. Each cat was given three trials per day according to the above described procedure.

Results

The results may be briefly stated as follows:

1. Of the 10 cats 3 became afraid of the rat not only in the apparatus but also in the test cage described above. One cat after 11 trials, one after 14, and the third after 16, began to run away when a rat was introduced into chamber two either of the test cage or of the apparatus, even when no shock was given. (Except in the first trial, the shock was given always thirty seconds after the rat was introduced to chamber two of the apparatus—so as to determine whether the conditioned response was already established in the apparatus.)

2. Two cats acquired the conditioned response of running away when a rat was present in chamber two of the apparatus, one after 9 trials, the other after 17 trials. But such responses could not be transferred to the test cage even after 50 trials. Practically on every trial, the cats made attempts to capture the rat in chamber two of the test cage even though all their attempts were fruitless on account of the wire-netting partition between the two chambers.

3. Five cats acquired the conditioned response of running away from the apparatus, usually after the fourth trial, even before the

rat was present. Obviously, the apparatus instead of the rat had become a conditioning stimulus.

We are fully aware of the fact that this part of the work is too crude to allow one to draw useful conclusions. But the fact stands out clearly that cats can be trained to fear or run away from the rat.

Realizing the crudeness of the work reported in this section and the need for more refined methods, we have planned to carry the investigation much further with the following problems in view:

1. To train young kittens which have not begun to kill rats to run away from rats by the electric shock method.

2. To train young kittens which have not begun to kill rats to run away from rats by seeing their mothers or other adult cats doing so.

3. Combination of 1 and 2.

4. To train non-rat-killer adult cats to run away from the rat by methods used in 1, 2 and 3.

Our first step would be to eliminate the apparatus as a conditioning factor, acting alone in producing the conditioned responses as well as acting in conjunction with other factors such as the rat.

XIV. SUMMARY

1. The main purposes of this investigation were to determine the effects of the following conditions on the behavior of the kitten toward the rat:

- a. Raising kittens in isolation.

- b. Raising kittens in a rat-killing environment.

- c. Raising kittens in the same cage with rats.

- d. Difference in food-habit, i.e., vegetarianism vs. non-vegetarianism.

- e. Hunger condition, i.e., testing immediately after feeding vs. testing 12 hours after feeding.

- f. Using re-enforcing stimuli, such as seeing the action of rat-killing by another cat to train kittens to kill rats.

- g. Using different kinds of rats, i.e., albino rat, wild gray rat and dancing mouse, to test the preferential responses of the cat to them.

h. Training the cat to fear the rat, i.e., to run away from the rat by the method of conditioned reflex.

2. Of the 20 kittens raised in isolation only 9 (or 45 per cent) killed rats without the so-called learning.

3. Of the 21 kittens raised in the rat-killing environment 18 or more than 85 per cent killed one or more kind of rats before four months old. The kittens always killed the kind of rat which they saw their mothers kill though they might kill other kinds of rats as well.

4. All kittens raised in the same cages with rats never killed their cage-mates, though 3 out of 18 killed other kinds of rats.

5. Of 11 non-rat-killing kittens 9 became rat-killers after seeing other cats in the act of killing rats. But with the exception of one kitten the reënforcing stimulus of seeing other cats killing rats had failed to make the kittens raised in the same cage with rats follow the same action.

6. Vegetarianism had no effect on rat-killing, but had effect on rat-eating.

7. Within the limit of our experiment, hunger condition appears not to have any effect either on rat-eating or on rat-killing.

8. It required an older and larger kitten to kill bigger rats.

9. Kittens that kill large sized rats will kill small rats of different species also.

10. Environmental influence has a great deal to do with what kind of rat the kitten preferred to kill.

11. The behavior of the kittens to rats was classified into 6 types: (1) positive, (2) negative, (3) oriented, (4) tolerant, (5) playful, and (6) hostile.

12. Of these types, type 6 was found to be closely related with type 1, while types 2 and 4 were dominant in the behavior of the non-rat-killing kittens.

13. Our results seem to indicate that larger sized rats are more likely than smaller ones to call forth hostile and negative responses from kittens, while small sized rats will more readily call forth killing and playful responses.

14. (1) Types 2, 3, and 5 for the kittens raised in isolation, (2) type 6 for kittens raised in the rat-killing environment, and

(3) type 4 for those raised in the same cage with rats had the largest percentages.

15. The responses of the kittens to the rats which were their cage-mates were classified into the following types: (1) negative, (2) tolerant, (3) playful, (4) protective, and (5) attaching.

16. We succeeded by the conditioned reflex method in training 3 cats to run away from the rat.

XV. DISCUSSION

In reviewing the results of this study, one is impressed with the fact that the behavior of the cat toward the rat is much more complex and much more variable than most psychologists would have thought. Shall we explain such complexity and variability of the cat's behavior in terms of instinct or in terms of learning? I do not think that these concepts are adequate to describe the responses of the cat to the rat. Nor do we need any such concepts. We have presented the actual behavior picture of the cat towards the rat in terms of stimulus and response together with the life history of the cat. Do we need to add that such responses are instinctive, such and such are learned by trial and error, and such and such are due to insight or ideation? Do we need to add that in our findings the cat shows instincts of rat-killing and rat-eating as well the instinct to love the rat? Do we need to resort to such concepts as modification of instinct, periodicity of instinct, waning of instinct and the like in order to explain the results of our study?

The cat is a small sized tiger. Its bodily make-up is especially fitted for capturing small animals; its body and legs are fitted for swift movements, its sharp paws and teeth are fitted for capturing and devouring; and its eyes and ears too, are very helpful in guiding its capturing responses. Here we have a machine so manufactured that under ordinary circumstances it will kill or even eat animals smaller than itself, such as rats, birds, etc. But its swift bodily make-up may also make it playful in response to small animals or small objects especially moving objects. Is it necessary to add that this machine has been endowed by heredity, through its nervous system with the instinct to kill rats and other small animals, and also another

instinct to play with them? Should this machine become as large as a tiger, it may even ignore smaller animals such as rats, etc., but will seek to kill much larger ones including men. Shall we say then, that this larger machine possesses an instinct to kill man, and another instinct to pity and forgive rats and other smaller animals? To me, the organismic pattern (please note that I do not mean neural pattern!) or bodily makeup and the size should be sufficient to tell why the cat behaves like cat, the tiger like tiger or the monkey like monkey. The cat has a cat-body and hence the rat-killing behavior; the tiger has a tiger body, and hence man-killing behavior. The chimpanzee has a chimpanzee body, and so uses sticks and does many things almost human. Have the cat and the tiger any instincts? Does the chimpanzee possess any insight? Is the cat's behavior toward the rat hereditary or learned through trial and error, or by imitation? To me, all such questions are useless as well as meaningless (see (2), (3), and (4)).

But the cat is a living machine; it grows and changes; it has a life history. Its behavior is being modified from the moment of fertilization to the point of death, and is modified according to the resultant forces of environmental stimulation, intra-organic as well as extra-organic. In other words, the kinds and range of potential responses of an organism are determined by its bodily size, and especially its bodily make-up or organismic pattern, while its actual responses are determined by its life history. Given an organismic pattern, its behavior can be modified at will by manipulating its life conditions. The function of the behaviorists is to discover the possible kinds and range of activities a given species can perform and to study ways and means to manipulate its responses at will. The ultimate purpose of the science of behavior—and of all other sciences—is “prediction.” And accuracy of behavior prediction depends on careful control and careful analysis of physiological factors, life conditions and momentary stimulations. The behaviorist refuses to have anything to do with such verbal labels as instinct, trial and error, insight, *gestalt*, purpose and the like, for such concepts are lazy substitutes for careful and detailed analysis of behavior.

The present study does not claim to have achieved the ideal of accuracy of prediction of behavior. In the first place, the work is still in its rough stage. Secondly, we have not touched upon the physiological side of the responses under investigation. Thirdly, we have not used enough cats to make our results reliable. And finally, we have not studied the behavior of cats toward birds and other small animals, which is so closely related to its behavior toward the rat that reliable knowledge of prediction could only be gained by studying both kinds of behavior. We hope that we shall be able in the near future to publish some more refined work on the cat's behavior toward the rat and other small animals. But the present study, rough as it is, should be sufficient to call attention to the fact that all the experimental investigations in the past in connection with the so-called unlearnedness of instincts, trial and error learning, imitation, insight or gestalt have been so superficial that the more fundamental aspects of behavior have been missed. Is there any wonder, then, that in spite of the fact that more than a quarter of a century has been spent in animal researches, so little has been done towards formulating laws for the prediction of behavior?

The point I am here making is that the mere proof or disproof of an instinct, i.e., action which can be performed without learning, the mere experiments on trial and error learning and the mere test to show the presence or absence of insight or intelligence and imitation will not lead us anywhere. We need to know the potential range or repertory of activities of a given species. We need to know the physiological and genetic or developmental aspects of each behavior. The behavior of an organism is a *passive* affair. How an animal or man will behave in a given moment depends on how it has been brought up and how it is stimulated. Without sufficient knowledge of the physiology of behavior and of the behavior history of the organism, prediction would be impossible. Our study has shown that kittens can be made to kill a rat, to love it, to hate it, to fear it or to play with it: it depends on the life history of the kitten. In the future with more refined methods, with more thorough investigation in this

direction and with more knowledge of the physiology of the cat's behavior, we should be able to predict in mathematical terms how a given cat will react to a given rat at a given moment. Prediction of behavior implies knowledge of behavior range, behavior physiology and behavior history. And behavior research means testing the ability of the experimenter to force the organism to behave in the way he desires with minimum energy, effect and time. Our behavior researches in the past have been in the wrong direction, because *instead of finding how we could build nature into the animal, we have tried to find nature in the animal.* Nothing is more natural than for the cat to "love" the rat. And if one insists that the cat has an instinct to kill the rat, I must add that it has an instinct to love the rat too. In behavior nature is what can be built in and not what is supposed to unfold from within. The science of behavior is the science of building nature into animals and men by the most economic methods available (of course, "nature" can be built in only within the potential limit of the organismic pattern). But so far our experimental researches have not been directed towards this goal.

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