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STUDY OF ANIMAL DRIVES

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INTRODUCTION

Basic Thesis: *The behavior of any animal is the resultant of his drives to action and the opposing resistances.*

It is a fact of common observation that animals when confronted by certain situations tend to respond with rather definite, fixed, behavior. It is to these tendencies to action that I apply the terms 'drive' and 'resistance.'

Drive.—By 'drive' I mean the impelling forces in the situation that stimulate the animal toward certain positive behavior. For example, if an animal is kept without food for a certain length of time, certain organic stimulations of the nerve-endings in the stomach provoke in the animal restless and seeking behavior until food is found and the "drive" for the time being, stopped. It is to the motive-force behind this seeking behavior that I apply the term 'drive.'

Resistance.—By 'resistance' I mean the repelling forces in the situation which stimulate the animal to negative reactions, or tend to draw him away from certain behavior. For example, the mere presence of cats produces in rats certain 'resistances,' and these 'resistances' stimulate the rats to behavior tending to keep, or remove, them from a closer contact with cats.

EXPERIMENTAL PROCEDURES AND RESULTS

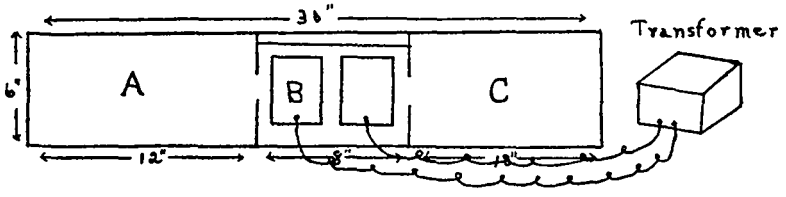
The animals used were white rats, ranging in ages from one hundred twenty-five to two hundred days. All males are distinguished by odd numbers and all females by even numbers.

Preliminary Training.—In a series of preliminary experiments in which the electric shock was used to produce the opposing stimulus, it was found that on the first trial the rat walked with little hesitation on to the brass plates, and when he had received the first shock he continued across the plates about as often as he turned back. However, in his subsequent experiences with the plates his behavior was quite different. As a rule, unless given some very strong stimulus which would make him do otherwise, he tended to keep clear of all contact with the plates. When given the necessary stimulus to make him approach the plates, he would go up to them very slowly and would cautiously reach out his foot to touch them. In most instances the foot was jerked back before it had even touched the plates. After crossing the plates and receiving the shock the second time, this avoiding behavior was more pronounced. I see no better way of explaining this change in the animal's behavior than to say that from his first two experiences with the plates he had "learned" to avoid them. From these experiments and from many other observations, I am convinced that with the lower animals as well as with the human, a single experience is very often sufficient to cause a marked change in the animal's future behavior. Take the following case as a typical illustration of my meaning: A rat stepped on the plates and received an electric shock of ninety volts. The effect of that single experience was sufficiently strong that when the animal was kept without food for three days and placed in the experiment box, with food on the opposite side of the plates, he would not touch the plates nor try to cross them to get to the food. Instead he tried to get to the food by climbing the sides of the box, and failing in this, he tried other methods equally futile. Altho left in the box for two hours, during which time he was almost constantly active, he always carefully avoided the only route that could bring success, the straight, direct route over the plates. Just as in the case of the man who having gone thru certain experiences is 'never the same again,' so this rat, having once received the shock, would never willingly come in contact with the plates again.

In order to make doubly sure that from the first of each experiment the brass plates might serve as a repelling stimulus, all animals used in the experiments were given two experiences with the plates before the actual experiment began. In these preliminary experiences they received a shock of 28 v. (twenty-eight volts).

I. The first experiment was devised to measure in terms of a constant resistance the strength of hunger drives varying in duration from twelve to one hundred forty-four hours.

In this experiment and in most of the others reported, I used an experiment box, the floor-plan of which is shown in the following diagram.



It was a simple box, 30 inches long, 6 inches wide and 12 inches deep. All sides except the front were made of wooden boards. The front side was made of wire fly-screen netting. It was divided into three sections, *A*, *B*, and *C*, the partitions being at *x* and *y*. The partitions were made of ¼ inch rat wire and equipped with doors of the same material. Section *A* was the full width of the box and twelve inches long. It was so made that it would hold water to the depth of one inch. When using the electric shock as an opposing stimulus, a small quantity of water was always kept in this section. On their way to the brass plates the rats passed thru this water and thus insured an almost perfect and uniform contact. Section *B* was eight inches long, but by nailing a board on the back side, the width was made five instead of six inches. In this section was placed the brass plates, so arranged that when the rat touched them he received an electric shock. In order to prevent the rat's trying to jump the plates or climbing the wire along the front, a wire screen was stretched about three inches above the plates, from partition *x* to partition *y*. This made it impossible for a rat to go from *A* to *C* without touching

the plates and getting an electric shock. The amount of current was controlled by a step-up transformer. Section *C* was ten inches long and the full width of the box, In this section the food was placed.

In this experiment sixteen rats were used, eight of each sex. They were divided into four groups of four each. Those in the first group were kept without food for twelve hours, those in the second group for twenty-four hours, those in the third group for forty-eight hours, and those in the fourth group for seventy-two hours before being given a trial in the experiment box. An electric shock of 20 v. was used for the stimulus opposing the drive. Each rat was placed in section *A* and left for one hour unless he crossed to the food in section *C*.

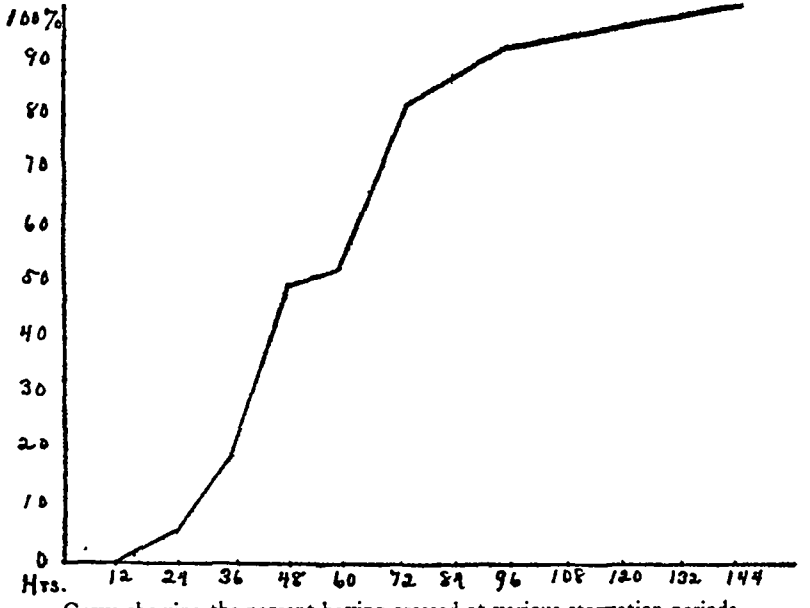
None of the animals in the first group, No. 1, 2, 3, and 4, crossed in the time allowed. While in the second group, composed of rats Nos. 5-8, only one, No. 6, crossed. In the third group, rats 9-12, three crossed, Nos. 10, 11, and 12. In the fourth group, 13-16, all crossed.

The eight rats that had failed to cross, Nos. 1, 2, 3, 4, 5, 7, 8, and 9, were kept without food for another twenty-four hours and placed in the box again. On this trial four crossed, Nos. 1, 2, 7, and 8, The remaining four were again deprived of food for another twenty-four hours and the procedure repeated.

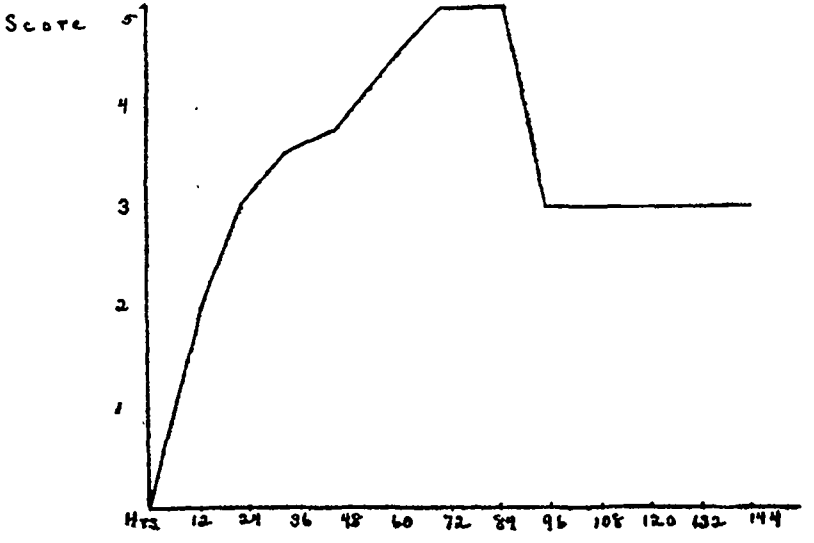
On this trial two crossed, Nos, 3 and 5. After the remaining two had been starved for an additional twenty-four hours, they were given another trial in the box and both crossed.

The activity of each rat on each trial was scored from 1 to 6, almost constant inactivity being scored 1, and practically continuous activity was scored 6. The average activity score with a twelve-hour hunger drive was only 2. Of those with a twenty-four-hour drive, the score was 3; with the thirty-six-hour drive the score was 3.5; with the forty-eight-hour drive the score was 3.75; with the sixty-hour drive the score was 4.5. With both the seventy-two and eighty-four-hour drives the score was 5. While with the ninety-six and the one hundred forty-four-hour drives the score dropped to only 3. This last low score was due to the inactivity of a large male, that was very sullen and inactive.

The following graphs show the percentages having crossed at the various starvation periods, also their activity score at these periods.



Curve showing the percent having crossed at various starvation periods.



Curve showing activity at various starvation periods.

II. After having determined the effects of varying hours of hunger, it appeared desirable to measure the comparative strength of a 72 hour hunger drive and a 28 v. resistance.

In the first experiment the resistance, or opposing stimulus, was kept constant at 20 v. and the strength of the drives was raised until *all* the animals overcame the resistance. While in the experiment that we are now considering, the strength of the drives was kept constant, being determined by a 72 hour starvation period, and the strength of the resistance by an electric current of 28 v. The same apparatus was used as in experiment one. Ten animals were used, five males and five females, Nos. 17-26. Each animal was placed in section *A* and left for one hour unless he crossed in the meantime to the food in section *C*.

With a 72 hour hunger drive the animals were very active, the average activity score for this group being 5. All the animals crossed in the time allowed except two, Nos. 22 and 25. These results would indicate that in four cases out of five a 72 hour hunger drive is stronger than a 28 v. resistance.

III. An effort was next made to measure the comparative strength of the sex drive and a 28 v. resistance.

There are many factors that determine the strength of the sex drive, such as age of the animals, their family inheritance, types of food they have been fed, state of health, etc. In a series of preliminary experiments it was discovered that there were very wide individual differences in the strength of the sex drive; one individual would sometimes overcome three times as much resistance to satisfy the sex drive as another. It was also found that there was not nearly so much difference among individuals of the same family as among those of different families. This was true not only in the strength of their drives but in the activity score as well. It was further shown that in the life of the same animal, the sex drive differs materially at different ages; ranging all the way from approximately zero strength during the period from birth up to about sixty-five days of age; then it has a very rapid increase in strength, reaching its highest point about the age of one hundred fifty or one hundred seventy-five days.

In as much as I wished to compare the results of this experiment with the results obtained in the second experiment, and thus gain some idea of the comparative strength of the sex and hunger drives, only those animals were selected for this experiment that had a brother or a sister among the group used in experiment two. Care was taken to get the two groups not only from the same families, but where possible, from the same litter.

The two groups were fed the same kind of food and kept under as nearly the same conditions as possible prior to these experiments.

As in experiment two, ten rats were used, five males and five females, Nos. 27-36. The same apparatus was used as in the first experiment, the only change being that the door to section *C* was closed in order to keep the rats that were used as a stimulus from leaving *C*. Otherwise those in section *C* would have been about as likely to cross to *A* as those in *A* to cross to *C*. It was so arranged that by attaching a string to the door and running it thru a series of pulleys, the door could be opened when an animal from *A* crossed the plates in *B*.

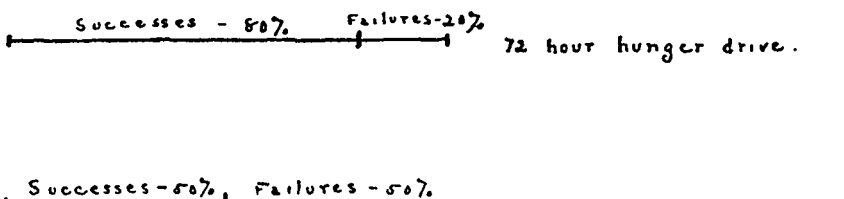
One of the females when in heat was placed in section *C*. The males were placed in section *A*. Only two of the males, Nos. 27 and 33, crossed to the female in the hour's time that they were left in the box.

The complement of this experiment was performed by confining the males in section *C* and leaving the female in section *A* free to cross the plates if she had sufficient drive to overcome the resistance. All the females thus tested were in heat. Three of them. Nos, 30, 32, and 36, crossed the plates in the time allowed.

It is of interest that when impelled by the sex drive only five of the ten overcame a resistance of 28 v., but when impelled by a 72 hour hunger drive eight of the ten overcame the resistance. The following lines will indicate the comparative success and failure of the two drives against the same opposing stimulus of 28 v.

Unless some important factors have been overlooked, these results would tend to disprove the commonly accepted theory that the sex drive is the strongest of all drives.

It is significant that when driven by the sex urge, three of the females crossed and only two of the males. These results might also throw the shadow of suspicion on the cor-



Successes and Failures

rectness of the statement that 'the male is essentially the pursuer and the female the pursued.' Whether the above statement is correct or not, these results certainly show that some females will overcome more resistance to place themselves in a position to be 'pursued' than will the average male in order 'to pursue.' The behavior of the female when admitted to section *C* would, at first glance, tend to support the statement that she is the pursued rather than the pursuer. On the approach of the male she responds with the proverbial 'fleeing' behavior, only she doesn't flee very far nor into inaccessible places such as back across the plates into section *A*. A quotation from Thorndike would very accurately describe this situation:

"The female responds by coy advances and retreats: the male by caressing pursuit and capture. The former is satisfied by, and so instinctively maintains, whatever augments the aggressiveness of the male; he responds similarly to the hopeful difficulties which her behavior offers. Capture and submission are responded to by the mutual absence of fear, . . . and by satisfaction in bodily contact, including as the final element the contact necessary for the fertilization of the ovum."

IV. Having determined the strength of the normal sex drive an attempt was next made to measure the effect of perversions on the strength of this drive.

The same apparatus was used in this experiment as in the preceding one. Care was taken to get animals of the same

age, and in so far as possible, of about the same physical condition as in the two preceding experiments.

Five males, Nos. 37, 39, 41, 43, and 45, were used. These rats had been kept in a cage by themselves from the age of twenty-five days till the time of this experiment, approximately one hundred fifty days. During this time they never came in contact with a female. On several occasions certain perversions of the homosexual type had been observed among them.

They were placed in section *A* in two groups, the first group containing two rats, and the second group the other three. A female in heat was placed in section *C*. The opposing stimulus was 28 v.

Altho left in the box for one hour, not a single one of the rats crossed to the female, nor did they seem to be excited by her presence. They were very inactive, their activity score being only 2. These results are very interesting when compared with those in experiment three. They would indicate that when the animal has found some way, other than the normal one, of satisfying the sex desire, the 'pulling force' of the normal stimuli on that individual is considerably weakened.

V. An effort was next made to measure the strength of the maternal drive.

In this experiment it was assumed that the strength of the maternal drive may be judged by the amount of resistance the mother will overcome in her efforts to go to her young, especially if she hears the distress cries of the young.

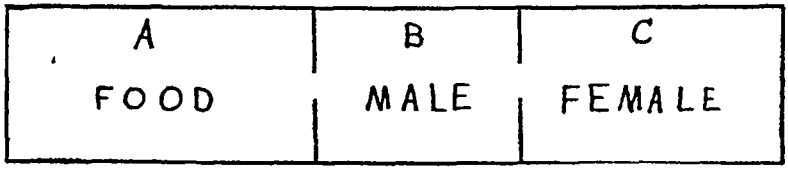
Five females, Nos. 38, 40, 42, 44, and 46, together with their newly born litters, were used in this experiment. The same apparatus was used as in the other experiments.

The mother was placed in section *A* and the little ones in section *C*. The little ones were punched and pushed about to make them squeal. In this way the attention of the mother was called to their distress.

Only one of the five mothers took the shock to get to her young. It happens that she was the wildest one in the group, and had been handled the least. The others were very tame.

It is quite possible that these rats had been handled so much that when they saw the hand of the experimenter punching the young ones, the distress cries lost their effect.

VI. In one of the earlier experiments an effort was made to determine the comparative strength of the sex and food drives by measuring the amount of resistance each would overcome. An attack was also made on the problem by balancing the two drives against each other, as shown in the following:



Food and sex balance.

In this experiment I used the same apparatus that I used in experiment three with the exception that the electrical apparatus was removed from section *B* and the door to section *A* was closed. The doors from section *B* to the other two sections were fixed so that they could be easily opened from section *B* but could not be opened from either of the other two sections, so that the animals could easily get into one of the other sections, but, once in, could not get back into *B*. All the rats used in this experiment had, prior to the experiment, been placed in section *B* and given the opportunity to learn that if they went into either *A* or *C* they were kept one hour before being taken out. All of the five had this experience four times before this experiment began. I gave them this preliminary training because I thought that it might have the effect of making the rats hesitate before going into the section from which he happened to get the first stimulus. This would give him the opportunity of getting the two sets of opposing stimuli from both sections before going into either.

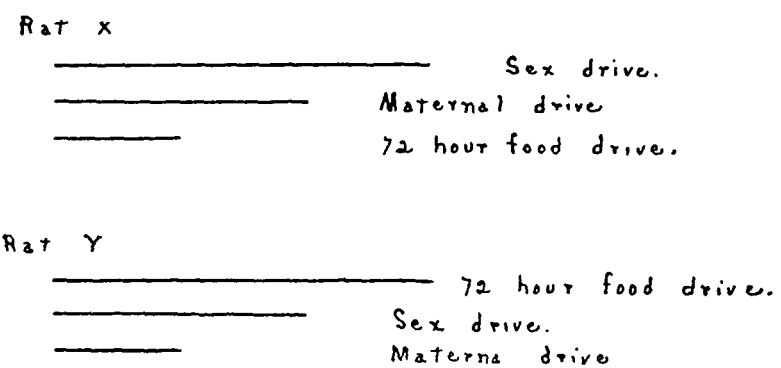
In this experiment the same five males were used as in experiment three, Nos. 27, 29, 31, 33, and 35.

A female when in heat was placed in section *C* and food was placed in section *A*. The males after having been de-

prived of food for 72 hours were placed in section *B* and given the 'choice' between food and sex gratification.

Only one rat, number 27, went into section *C*; the other four went immediately to the food in section *A*. It seemed to take No. 27 a long time to 'make up his mind.' He ran first to one partition then to the other. He would stick his nose thru the wire of one partition then go over to the other and repeat the behavior. If animals have "mental conflicts" I would judge from his behavior that he experienced one. Be that as it may, after being in section *B* thirty-two minutes he went into section *C*.

It is worth noting that number 27 was the rat that in experiment three overcame the resistance of 28 v. to satisfy his sex drive. Of course one case shows little, but from my other observations on rats, I have a feeling that if we were to test a sufficient number of cases, we would very likely find the sex drive in some rats three or four times as strong as it is in others of the same age and sex. At the same time, the rats with the strong sex drive may be weak in other drives. The following lines will illustrate some individual differences in drives. The length of the line indicates the strength of the drive.



Taken uncritically, these results would indicate that the 72-hour hunger drive is considerably stronger than the sex drive. But we should consider that in this experiment we may not be measuring the normal strength of the sex drive. It is quite likely that as the hunger increases the sex drive

decreases. To illustrate, it is conceivable that with a full stomach, the sex drive is equal to 100 units, but with an empty stomach, due to having been deprived of food for seventy-two hours, the strength of the sex drive is only 65 units. A series of experiments to be conducted in the near future has been planned which will tend to clear up this point.

VII. In the next experiment a study was made of the rat's choice between the 'lesser of two evils.' This was done by measuring the amount of decrease in temperature of the water in which the animal was standing, necessary to force the animal to climb on a brass plate where he received a 12 v. shock.

The same apparatus was used as in experiment one with the addition that section *A* was filled with water to the depth of one half inch. Crushed ice and a thermometer were also provided. The transformer was set to turn a 12 v. opposing stimulus on the plates. Section *C* contained neither food nor female.

Ten animals were used. When the temperature of the water was around 25 degrees centigrade, the animal was placed in section *A*. Crushed ice was quickly poured into the water until the temperature of the water was reduced sufficiently to make the animal climb out of it on to the plates. In this experiment we have one resistance overcoming another. It is what the moralists might call 'the choice between the lesser of two evils'; while the man on the street would describe the situation as being 'between the Devil and the deep blue sea.' Regardless of what name is given to the situation, the actual results are shown in the following tale.

Temperature	Cases Climbing Out
20–25° C	0
15–19 C	1
10–14 C	1
5– 9 C	5
1– 4 C	3

VIII. The next experiment was planned to determine the amount of reinforcement necessary to make a twelve-hour hunger drive overcome a 28 v. resistance.

Here we have a situation in which the resistance is very much stronger than the drive. In the first experiment we found that a 12-hour hunger drive was in no instance strong enough to overcome a 28 v. resistance. In the present experiment we are trying to add to this drive an antagonistic resistance that will make it able to overcome the opposing resistance.

The same apparatus was used as in the last experiment with the addition of food in section *C*. The transformer was set for 28 v.

Ten animals, five males and five females, were used. The animals having been deprived of food for twelve hours were placed in section *A* and crushed ice was fed into the water until they crossed to section *C*. The temperature of the water was recorded at the time each one crossed.

The following table shows the amount of reënforcement necessary to make the twelve-hour hunger drive overcome the 29 v. resistance.

Temperature	Number Crossing
20–25° C	0
15–19 C	2
10–14 C	4
5– 9 C	2
0– 4 C	2

IX. In the next experiment an effort was made to measure the effect of having overcome a resistance upon the strength of the resistance.

In this experiment I used the same apparatus and the same animals that were used in the last experiment. For five successive days the animals were tested under approximately the same conditions as in the last experiment. All animals were kept without food for twelve hours before testing. The resistance, or opposing stimulus, was kept at 28 v.

On the first trial the temperature of the water had to be lowered on the average to ten degrees *C*. before the animals crossed. On the second trial the average temperature at which the animals crossed was two degrees higher, 12° C. On the third trial it went up to 13.5° C. While on the fourth there was no improvement, in fact a slight falling off over the

last trial. On this trial the average temperature was approximately 13° C. On the fifth trial there was an improvement, the average temperature being raised to 14° C.

Thus we see that five trials reduced the amount of reenforcement necessary to make a twelve-hour drive overbalance the 28 v. resistance, by about four degrees C. From these results it is reasonable to conclude that a resistance tends to lose its repelling force each time it is overcome.

X. It is a fact of common observation that when an act is performed and followed immediately by punishment that that act is less likely to be performed again. A series of experiments were devised to measure the effect of punishment on the rats' hunger drive for cheese.

In one corner of a simple cage was placed a block of cheese, three inches long and one inch in width and thickness. The approach to this was so guarded by brass plates that every time the rat tried to nibble the cheese, he got an electric shock of 60 v.

In this experiment five rats were used. The rats were kept supplied with a liberal amount of food, other than cheese, so that they could not become very hungry. The animals were left in the cage with the cheese thus protected for one week. When the protecting electrical apparatus was removed, none of the animals disturbed the cheese, although it was left in the cage unprotected for a week. From these results we are led to conclude that by punishment we can build up in an animal a permanent inhibition of a desire for a particular kind of food.

Prof. J. J. B. Morgan, in an unpublished experiment, has studied the effect of punishment on the sex drive. He placed three males and three females in adjoining cages separated only by a wire partition and left them for several weeks. Every time they tried to get in contact with each other they got an electric shock. Among his other findings is the interesting case of a female whose normal sex behavior was so disturbed that ever afterwards, she fled in terror at the mere approach of the male.

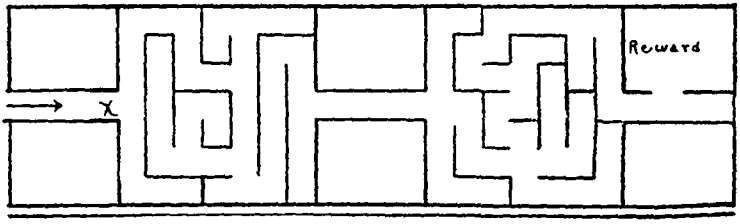
XI. From time immemorial a battle has been raging in the field of education concerning the comparative worth of punish-

ment and reward as incentives in learning. With the hope that some light might be thrown on this problem from the field of animal psychology, an experiment was devised to measure the comparative efficiency of the hunger drive, the sex drive, and the resistance to cold, as motive forces in learning a maze.

There are three elements that must be considered in attempting to measure the efficiency of learning methods: the time it takes to learn the problem; the number of errors made in learning it; and the durability, or permanancy of the learning.

The maze used in this experiment was of the same general pattern as number three of the Army Beta Intelligence test. All the alleys were four inches wide and all other parts were extended in proportion. The following diagram needs little explanation.

3.



The rats were placed in the maze at "*X*." In the compartment marked "Reward" was placed the food or the female while trying the first two sections of this experiment; when working on the third section of the experiment, this part was the only part of the maze that did not contain ice.

Fifteen animals were used, five for each part of the experiment. They were about the same age, and special care was taken to get the groups as similar as possible.

The five animals in the first group were kept without food for 48 hours and placed in the maze one at a time. The time and errors were recorded for each. The average time taken by the five in this group to find the food on the first trial was 38 minutes with 29 errors. They were permitted to eat for fifteen minutes, and then removed from the maze. They were given another trial the next day. This time they made

it in 21 minutes with only 17 errors. They were again permitted to eat for fifteen minutes and removed.

This procedure was repeated for the next three days. The average time for the five on the 3d, 4th, and 5th trials was in 3 min. 50 sec. and the average number of errors was 7.

In the second part of the experiment where the sex stimulus was used, five males were placed in the cage one at a time and a female in heat was placed in the 'reward' box. The time and errors were recorded as in the first part. When the male reached the reward box he was left in it with the female for fifteen minutes. The average time of the first trial for the rats to find the reward box was 49 minutes with 31 errors. On the second trial the average time was 22 min. 14 sec., with 19 errors. The average time for the 3d, 4th, and 5th trials was 3 min. and 5 sec., with 8 errors.

In the third part of the experiment where punishment was used as the incentive, the floor of all parts of the maze except that of the 'reward' box was covered with crushed ice. The only way the animals could escape from the cold was to go to the reward box. The average time on the first trial was 36 minutes with 29 errors. On the second trial the average time was 28 minutes with 18 errors. And the average for the 3d, 4th, and 5th trials was 5 minutes and 20 sec. with 12 errors.

The results of the three parts of the experiment are combined in the following table.

TIME TABLE

Trial	Food	Sex	Punishment
1st	38 min.	49 min.	36 min.
2d	21 "	22m. 14 s.	28 "
3d, 4th, 5th	3 m. 50 s.	3 m. 5 s.	5 m. 20 s.

ERRORS TABLE

Trial	Food	Sex	Punishment
1st	29	31	29
2d	17	19	18
3d, 4th, 5th	7	8	12

Thirty days later these tests were repeated to measure the permanency of the learning. Each rat was given two trials.

The average results of these two trials are shown in the following table:

	Food	Sex	Punishment
Time	6 min. 40 sec.	5 min. 12 sec.	10 min. 18 sec.
Errors	16	13	17

These results would indicate that for immediate efficiency it makes little difference whether you use the sex or food rewards. Both seem superior as incentives to this particular punishment method. When the permanency factor is considered it seems that the sex reward works some better than that of food; and that the punishment method is much inferior to both of these.

General Discussion of Experiments

In the foregoing experiments I have endeavored to set forth a method whereby some of the so-called 'intangible' elements of animal behavior can be objectively measured. This method enables us to evaluate the 'motives,' or impelling forces, in behavior. In the past, students of animal behavior have been too content to study the mere act and have paid little attention to the impelling forces in the act. While the methods used here are admittedly very crude and imperfect, it is hoped that they will serve as a starting point for further investigations which will devise a greatly improved technique to replace them.

There was a time in the history of the race when our forefathers were very pleased to be able to measure things in pounds, for it was so much more accurate than guessing. They were even more pleased and certain of their results when they got down to ounces. The ounce as a fine unit of measure has yielded place to the grain, and the grain in turn has been replaced by still finer units of measure and they by still finer and more accurate, until to-day the U. S. Bureau of Standards has perfected an instrument that will measure accurately down to the 1/50,000,000 (one fifty millionth part of an ounce). The instruments used in these experiments may not even be perfected to the pound stage of accuracy, but they at least get

away from the "popular guessing contests" which have been characteristic of the various attempts in the last twenty-five years to find 'the one' impelling force, or instinctive drive behind all animal behavior. A current example of such a 'guessing contest' is the attempt of some of the over-enthusiastic disciples of Freud to explain everything in terms of the sex drive. By the methods described in this paper we can prove that the animal has not only many other drives and resistances which play a very large part in determining his behavior, but we can show that some of these other drives are even stronger than the sex drive. Take for example the results obtained in experiments three and six. These two experiments objectively prove that a situation caused by keeping the animal without food for seventy-two hours generates in him a stronger drive than will the situation caused by the presence of a female in heat.

It is no longer a matter of opinion as to the strength of a steel beam: Construction engineers can very accurately measure the amount of stress and strain that it can withstand. They have been able to do this by substituting numerical facts for opinions, reliable units of measure for mere guess work. The methods used in these experiments at least yield their results in numerical measures, however crude and coarse they may be. With the perfection of these methods it is reasonable to expect that the human engineer will also be able to measure the strength of the materials with which he deals, and to tell with a high degree of accuracy the amount of stress and strain an individual may be expected to withstand.

Conclusions

The primary object in performing these experiments was to develop a method for numerically measuring drives and resistances. The experimenter was only incidentally interested in reaching conclusions as to the relative strength of the various drives and resistances. The only way to be certain that the average performance of a group is typical, or thoroughly representative, of what you might expect from that species, is to have a fairly large number of chance-selected

animals in the group. While great care was taken to eliminate all apparent selection, yet, owing to the small number of animals in the various groups, it is possible that in some cases the element of selection entered. This should be kept in mind when making any sweeping conclusions from this data. This precaution should be remembered while reading the following conclusions which these experiments seems to justify.

1. Experiment one shows that a resistance may be overcome by increasing the strength of the drive. It also shows, as do most of the other experiments, that vast individual differences exist in the strength of the different drives and resistances.

2. Experiment two shows that if a 72-hour hunger drive is opposed by a 28 v. opposing stimulus, or resistance, in eight cases out of ten the hunger drive will overcome the resistance. A 72-hour drive would then seem to be about the threshold for overcoming this resistance.

3. Experiment three shows that a 72-hour hunger drive is in most cases stronger than the sex drive. It also shows that the female will overcome as much, or more, resistance to secure sex gratification, as will the male.

4. Experiment four shows that perversions tend to very greatly weaken the strength of the normal sex drive.

5. Experiment five tends to show that the maternal drive is not as strong as the sex or 72-hour food drive.

6. Experiment six shows that with most animals the 72-hour food drive is stronger than the sex drive. It also shows that the sex drive is in some animals much stronger than it is in others. Take for example the case of rat No. 27.

7. Experiment seven shows that one can make an animal choose something which is very repulsive by making the other possible choice more repulsive. (I believe most suicides show this overcoming of a natural resistance by a still stronger resistance.)

8. Experiment eight shows that although a drive may be much weaker than a resistance, it can be reënforced by other drives or antagonistic resistances until it overcomes the resistance.

9. Experiment nine shows that overcoming a resistance tends to weaken the strength of the resistance.

10. Experiment ten shows that we can greatly modify and possibly break down a natural drive by punishment.

11. Experiment eleven indicates that rewards are better than punishments as motive forces in learning such problems as the maze.

From the results obtained in these experiments, I believe that we are justified in stating the following general theses which may be used in the interpretation of any animal behavior, whether the behavior be that of a rat, dog, horse or human.

1. Any animal drive may be measured in terms of the resistance overcome, provided the strength of the resistance is known. Or, where the strength of the drive is known and that of the resistance is not, the resistance may be measured in terms of the drives.

2. Any drive that succeeds is stronger than the resistance overcome, and any drive that fails is not as strong as the resistance. For example, if a hunger drive caused by a forty-eight-hour starvation period, will make the animal take an electric shock of 12 v. to get to food, but fails to get him to take the shock of 20 v., we may say that the strength of a forty-hour hunger drive lies between a 12 v. and a 20 v. opposing stimulus, being stronger than the 12 v. but weaker than the 20 v.

3. If two independent drives are opposed by the same resistance and one drive overcomes the resistance while the other fails, the one that overcomes the resistance is the stronger drive. For example, if a seventy two-hour-hunger drive overcomes a 20 v. resistance and a sex drive fails to overcome the same resistance we may conclude that the hunger drive is stronger than the sex drive.

4. Given two drives both functioning at the same time, and so arranged that neither can succeed without neglecting the other, the one that succeeds is the stronger drive. This is well illustrated in the balancing of the hunger drive against the sex drive in experiment six.

5. Given two antagonistic resistances both functioning at the same time and both so arranged that neither can cease to function without overcoming the other, the one that overcomes is the stronger resistance. This is illustrated in experiment seven, where the two opposing stimuli are the ice and the electric shock.

6. When one drive by itself is not strong enough to overcome a resistance, it may be reënforced by other drives, until it is strong enough to overcome the resistance. Experiment eight is a very good illustration of this thesis.

7. As a motive force in provoking the learning of such problems as the maze, that drive is strongest which causes the animal to learn the problem in the shortest time and with the fewest errors. This was illustrated in experiment eleven.

8. Other things being equal, every time a resistance is overcome, the strength of that resistance is weakened. This is illustrated in experiment nine.

9. The combined results of these eleven experiments seem to substantiate the basic thesis that *the behavior of any animal is the resultant of his drives to action and the opposing resistances.*

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