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An Investigation of Food Deprivation and Competition on Hoarding Behavior in the Domestic Cat

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AN INVESTIGATION OF FOOD DEPRIVATION AND
COMPETITION ON HOARDING BEHAVIOR
IN THE DOMESTIC CAT

by

Jo Ann Sinclair

A thesis presented to the
Faculty of the School of Graduate
Studies in partial fulfillment
of the
Degree of Master of Arts

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Jo Ann Sinclair

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AN INVESTIGATION OF FOOD DEPRIVATION AND
COMPETITION ON HOARDING BEHAVIOR
IN THE DOMESTIC CAT

Hoarding has been operationally defined by psychologists as the retrieving and accumulation of food objects. A large body of evidence exists concerning the hoarding of food and other objects by rodents. Some of this evidence is anecdotal, in particular that concerned with pack rats and squirrels, but much of it involves controlled studies of hoarding by the laboratory rat. A survey of this literature finds no mention of any controlled studies of hoarding by carnivores, nor any anecdotal evidence of behavior that is labeled "hoarding."

However, Flower and Lydekker (1891) stated that the tiger kills its prey, drags it to a secluded place, and remains near until it is consumed. Adamson (1960, 1961) described similar behavior by the African lion, and according to Drimmer (1959), the cougar covers its kill with brush and returns to feed on it for two or three days.

The wild members of the cat family mentioned above do retrieve objects, one of the conditions of the definition of hoarding, but they cannot be said to accumulate them. However, it might be possible that, given appropriate objects, cats might learn to accumulate under conditions of deprivation.

There is no unifying theory explaining rodent hoarding

but there appear to be a number of conditions relevant to the behavior. Hunt (1941) interpreted hoarding by rats as a learned reaction to deprivation. He also found that among adult rats hoarding was more intense when they had also been deprived early in life. Licklider and Licklider (1950) found that rats hoarded at an accelerated rate when deprivation was discontinued and they were satiated.

Munn (1950) considered an accumulation of physiological drives to be the primary motivation for hoarding rather than hunger per se. He concluded that deprivation was necessary for the induction of the behavior, but that the goal of the activity was the activity itself and not the accumulation of food, since rats continued to hoard for some time after an adequate food supply was available. The activity extinguished gradually.

Morgan and Stellar (1943) stated that rats hoarded more to a familiar cage, hoarded more familiar objects than unfamiliar, and that the presence of other animals had little effect. Miller and Viek (1944) also found that familiarity with the test situation intensified hoarding.

There is a lack of studies employing similar variables with cats. If hoarding could be induced in cats, it might prove to be a behavior that could serve as the basis for comparative studies across phylogenetic lines.

While the present study was concerned with domestic cats, studies on rats were reviewed to see what methods

might be adapted, since rats have been used most frequently in hoarding studies.

Deprivation appears to be necessary to initiate hoarding in rats, thus deprivation was selected as the principal variable to be investigated. Since cats appear to be social animals, the presence of other animals was selected as the second variable.

Method

Two experiments were conducted, the first under conditions of community feeding and the second under conditions of individual feeding to see what effect, if any, social factors would have upon the behavior of cats under deprivation.

Individuals from two litters of kittens were used as subjects in the experiments. The parents of both litters were the same, the mother a Siamese, reared by the experimenter at home, the father a stray of unknown parentage.

One litter was born in the experimenter's home where the kittens lived until seven weeks of age when they were removed to the laboratory. The laboratory was a large room with small experimental rooms adjoining. The cats lived together in a colony in one of these rooms until the beginning of the experiments.

The other litter was born in another experimental room in the laboratory, but only one kitten, a female, survived. She lived with her mother until she was five weeks old at which time the mother was removed. She lived alone in the room until she was three months old, then was placed in the colony where she lived until the experiments were begun.

The cats were free to move about their room, and were released into the large laboratory several times each week

where they were permitted to explore and play.

All cats were fed ad libitum during colony life.

The experimenter observed the animals periodically both in the testing room and the large laboratory, sometimes remaining in the rooms with the cats, sometimes observing them through one-way mirrors. The experimenter handled the cats and played with them so they would be accustomed to her.

Experiment I

To determine the effects of deprivation and social relationships between cats competing for food, the experimenter decided to run the experiment in five phases. The experimenter was present in the experimental room during the test periods of all phases.

Subjects

Three males from the first litter, 11.5 months of age, were subjects.

Phase I

Each cat was placed in a separate cage with an attached alley. He was fed Snelling's Dog Biscuits ad libitum in the cage for 10 days. The biscuits were one-and-one-half inches long.

Miller and Viek (1944) found in rat studies that for optimum hoarding the visual and olfactory aspects of the test situation should be familiar and that strangeness of the cage, alley, or food pellets reduced hoarding. They concluded the cage was the most important aspect. Morgan and Stellar (1943) stated that rats hoarded more to a familiar cage.

This phase was conducted not only to adapt each cat to a home cage, alley, and food object, but also to encourage the development of territoriality. During this

phase the consumption of biscuits was measured to determine the average for each animal.

Phase II

This phase was conducted to determine the average consumption of the three cats when feeding from a central source for a limited period.

Each of the three alleys with its cage was attached to a large central feeding cage (CFC) (See Fig. 1). The animals had access to the CFC only during a daily 30-minute period, but had access to his own cage and alley at all times. Water was available in each animal's home cage.

After 23½ hours deprivation, 300 grams of biscuits, a more than adequate supply, were placed in CFC and the animals were released and given free access to CFC and all three home cages and alleys during the test period. After this period, the remaining biscuits were removed and weighed and the cats were returned to their respective cages and alleys. Phase II continued for 10 days.

The experimenter was interested chiefly in the possible hoarding behavior of the subjects, but was interested also in various social behaviors and behavior patterns which occurred in colony life and which might change under deprivation, such as aggression, territoriality, exploration, activity level, reciprocal grooming, and vocalization

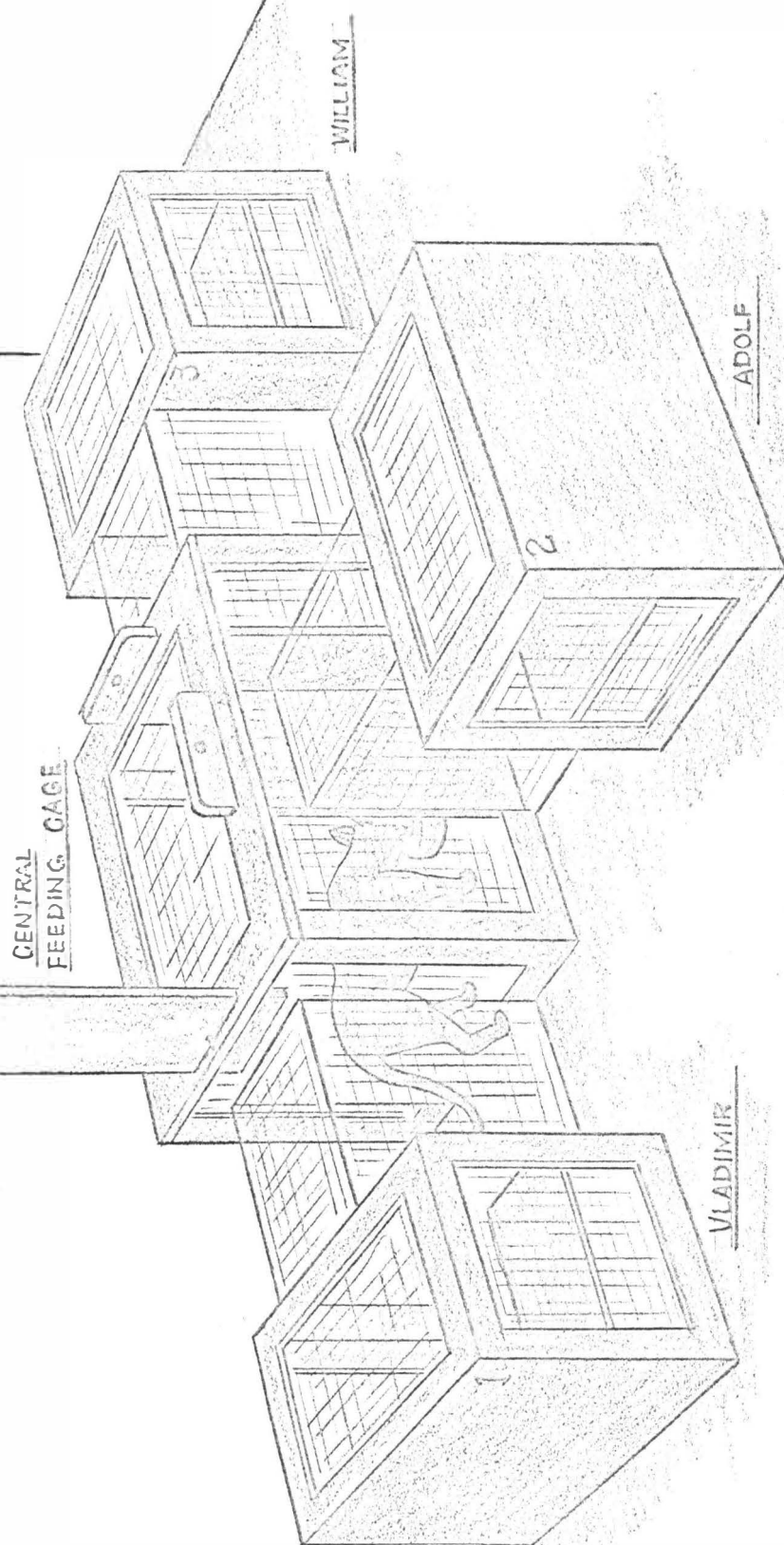


FIGURE 1. TEST APPARATUS USED FOR
EXPERIMENT I

Beginning with this phase and throughout subsequent phases observations were made and are discussed in the appendix.

Phase III

This phase followed the same procedure as Phase II, but the supply of biscuits was reduced to 50 grams, an inadequate supply, to see if deprivation would induce hoarding behavior. Phase III continued for 10 days.

Phase IV

Phase IV was identical to Phase II, i.e. conditions of adequate food supply, since in rat studies rats continued to hoard after deprivation when the food supply was adequate (Licklider and Licklider, 1950). This phase was conducted for five days.

Phase V

Phase V was suggested by a study which found that some rats do not hoard from a central bin, but steal from other animals (Morgan, 1947). During this phase, which continued for six days, 300 grams of food were placed in the home cage of one of the cats on a random schedule so that each cage contained the food on two days.

Results Experiment I

The results obtained during the five phases of Experiment I are summarized in Table 1. It can be seen that under the various test conditions no hoarding was demonstrated by any animal.

During Phase I, the total consumption of each cat varied from day to day, ranging from 50 grams to 130 grams in 24 hours. Vladimir (V) consumed an average of 80 grams daily, Adolf (A) and William (W) averaged 92 grams each. The average daily consumption for the three cats was 274 grams, thus the 300 grams of food presented during Phase II were considered more than adequate. However, the cats had been fed ad libitum from birth until the experiment was begun, hence the 30-minute feeding period during Phase II was judged inadequate. Under these conditions deprivation was considered to be accumulative from day 1 through day 10.

Although the three cats consumed more and more each day throughout the 10 days with the exception of days 4 and 9, they never reached the average daily consumption of Phase I, falling 98 grams short on the tenth day. Consumption, on days 1 through 10, was 84, 72, 111, 103, 123, 138, 145, 165, 130, and 176 grams. The average daily consumption was just 46% of the group average for Phase I.

Table 1

Incidence of Hoarding for Each Cat in Experiment I

Subjects	Phase I ^a	Phase II ^b	Phase III ^c	Phase IV ^d	Phase V ^e
Vladimir	No hoarding	No hoarding	No hoarding	No hoarding	No hoarding
Adolf	No hoarding	No hoarding	No hoarding	No hoarding	No hoarding
William	No hoarding	No hoarding	No hoarding	No hoarding	No hoarding

Note.--Phases I-III continued for 10 days, Phase IV for five days, and Phase V for six days. Food was presented only during the 30-minute test period during Phases II-V following 23½ hours deprivation.

^aAd libitum feeding in individual home cages.

^bAdequate food supply in CFC

^cInadequate food supply in CFC

^dAdequate food supply in CFC

^eAdequate food supply in alternate home cages.

No hoarding occurred, nor did any cat carry a biscuit out of the feeding cage to consume away from the others.

The 50 grams of food presented during each test period of Phase III were considered sufficient for deprivation based on the average daily consumption of the three animals during Phase II, yet no hoarding occurred.

The quantity of food presented during Phases IV and V was increased to 300 grams, the amount in Phase II. Consumption during both these phases fluctuated as it had during Phase I, the average being 150 grams, a 20% increase over Phase II. Consumption on days 1 through 11 was 208, 124, 178, 143, 150, 146, 168, 126, 150, 117, and 136 grams. No hoarding or retrieving occurred during Phase IV.

On day 1 of Phase V when food was placed in cage 2, V carried biscuits to CFC on three occasions and consumed them there. Adolf removed food from the cage to alley 2 where he consumed it on four occasions. Cage 2 was A's home cage.

Each cat carried food from cage 1 to alley 1 and consumed it on day 2, A on two occasions, W and V on three, Cage 1 was V's home cage.

No retrieving occurred on day 3 when food was placed in cage 3, W's home cage.

Both A and V carried food from cage 1 to alley 1 and consumed it on four occasions on day 4.

On day 5, W and A each carried a biscuit from cage 3 to alley 3 once and consumed it there.

On day 6, the final day of the experiment, V carried food to alley 2 three times and to CFC once.

V and A each carried biscuits away from the food source 15 times, W four times, but none ever retrieved to his home cage. No hoarding occurred during Phase V.

Discussion

Speculation on the possible reasons no hoarding occurred under any of the test conditions suggested three possibilities.

Under natural conditions, hoarding is unknown among cats. Under the artificial conditions of the laboratory, the experimenter may have attempted to induce behavior which could not be elicited under any conditions. If hoarding were a purely instinctive behavior when it occurs, and if cats lack this instinct, then the manipulation of the present variables would not elicit the behavior in cats.

However, if hoarding is an instinct which is triggered by external and/or internal stressful stimuli, and if cats possess this instinct, then the proper manipulation of pertinent variables should elicit the behavior.

If hoarding is a learned reaction to stressful stimuli, such as deprivation, and if cats possess the capacity to learn the response, then the behavior should be subject to induction in the laboratory.

If the second or the third proposition is true, i.e. if the behavior could be induced under the proper conditions, several possibilities are suggested for the failure to elicit hoarding in this study.

First, there was no preliminary investigation to determine how long a cat can go without food. The deprivation

schedule may have been too short to induce the desired behavior. This suggests a study in which several groups of cats would be tested under varying periods of deprivation from 24 hours to perhaps one week. There may be an optimal degree of hunger for the induction of hoarding in cats.

Secondly, dog biscuits are not natural food. All species of wild cats are hunters and kill their food. Even the domestic cat that is well fed hunts birds and small mammals and often carries his kill home. This suggests the possible existence of a mechanism that is triggered by the stalking and killing of prey.

To test this idea, on the final day of the experiment, the cats were not confined to their home cages and alleys but allowed to roam throughout the apparatus. Three-hundred grams of food were placed in CFC.

The next day under conditions of freedom and assumed satiation, a live rat was placed in CFC. All the cats appeared to see the rat about the same time, and all "stalked" the immobile prey. W struck the rat first, grasping it with his jaws by the throat, as described by Adamson (1960), the lion's characteristic method of killing. W growled and the others withdrew a short distance and crouched. The only alley unimpeded by the crouching cats was alley 1. W raced with the rat to cage 1, followed by A and then V. W turned to face A who stopped short in the

door of the cage when W snarled. When A remained motionless for a time, W relaxed, dropping the rat and again striking and grasping it by the throat when the rat moved. Then A placed one paw on the rat. W snarled and struck at A who withdrew to alley 3. W ran quickly to cage 3, his home cage, again followed by the others as far as alley 3. After a short time V withdrew to cage 1, and A entered cage 3. W snarled and ran to CFC, followed by A. W immediately returned to cage 3 where the kill was completed. A crouched in alley 3 watching and V watched from alley 2.

The above behavior occupied a 10 minute period. A continued watching W for about two more minutes, while W growled. Then A withdrew to CFC, whereupon W commenced eating the rat. The rat was forcibly taken from W by the experimenter.

The rat appeared to release in the cats a pattern of behavior that was not observed at any time during the experiment, although similar behavior occurred in colony life when the cats were given a bone or piece of meat. This suggests that natural food objects, i.e. living prey, might be used in similar hoarding experiments.

Another possible reason no hoarding occurred is that the cats had lived together from birth. They may have comprised a "pride" as do lions. The lion pride shares its kill, although a hierarchy of "places at table" exists as described in the literature (Adamson, 1961, 1962;

Drimmer, 1959). This appears to be true of domestic cats who live together. They also ate together with no fighting during colony life and during the experiment, even when the food supply was reduced to 50 grams daily.

This suggests using, in the future, a group of cats who are strangers.

Experiment II

The purpose of the second experiment was to determine the effects of deprivation on partially isolated cats in regard to hoarding. The experiment also was a control for Experiment I since the effects of social factors could not be separated from the effects of deprivation in the community feeding situation. It was conducted in four phases.

Experiment II was begun on the first day of Phase IV of Experiment I. Since deprivation and competition for food had been insufficient to induce hoarding in the first experiment, the experimenter decided to reduce Phase II through Phase IV of Experiment II to five days each.

The experimenter was present in the experimental room during the test periods.

Subjects

The subjects were two female cats, one a littermate of the three males used in Experiment I, about 12 months old, the other from the second litter and six-and-one-half months younger than the first.

Phase 1

Phase 1 of Experiment II was identical to Phase 1 of Experiment I.

Phase 11

The cats' home cages were placed back-to-back in the

colony room with a barrier between them so the animals could hear but not see each other (Fig. 2). The cats had access to their individual home cages and adjoining feeding cages throughout Phases II, III, and IV. Water was available in the home cages.

After 23½ hours deprivation, 150 grams of biscuits, a more than adequate supply, was placed in the feeding cages at the beginning of the test period and the remainder removed after 30 minutes.

Phase III

An inadequate food supply, six grams for the older animal and seven grams for the younger, was placed in the feeding cages at the beginning of each test period. The food dishes were removed at the end of the 30-minute period.

Phase IV

A more than adequate food supply again was given each animal during the daily test period of 30 minutes.

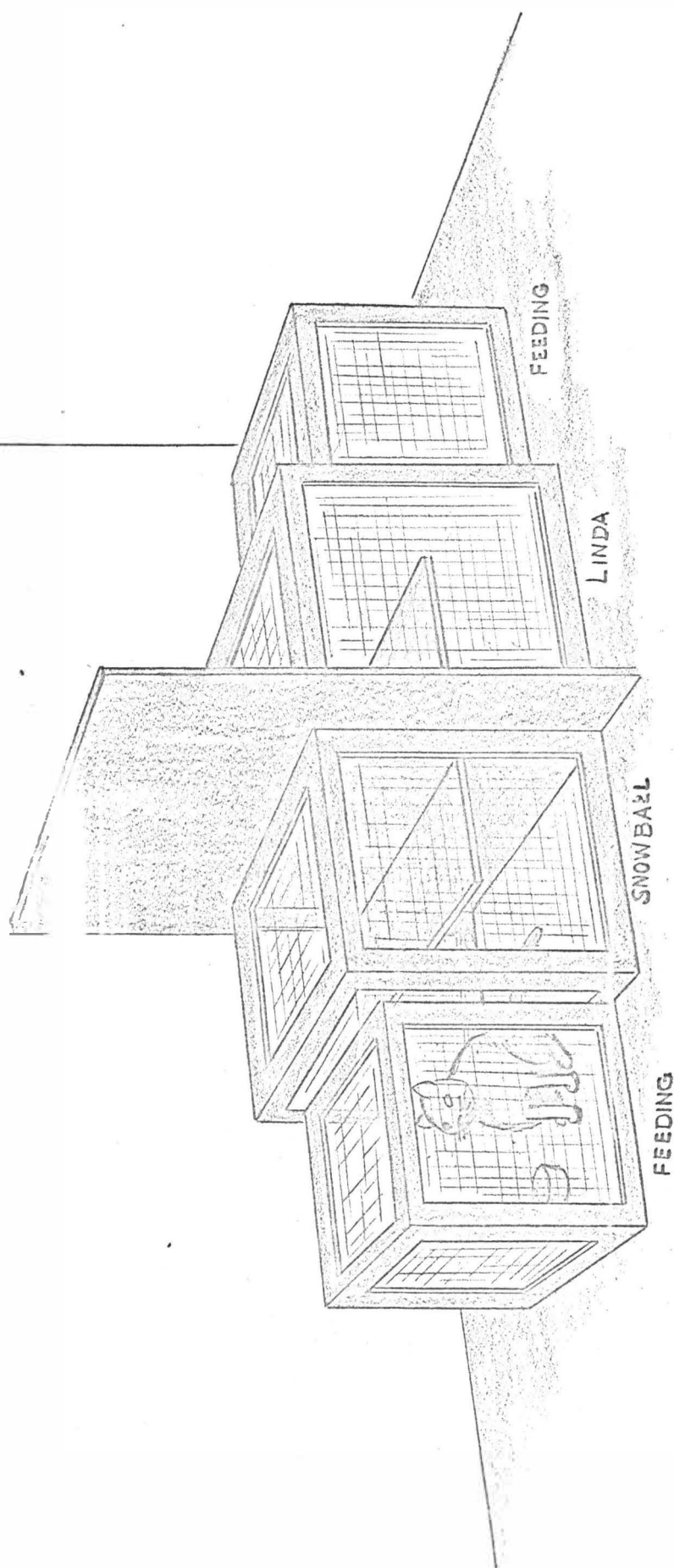


FIGURE 2. TEST APPARATUS USED FOR
EXPERIMENT II

Results Experiment II

No hoarding was observed during any phase of the experiment. The results obtained during the four phases of Experiment II are summarized in Table 2.

Consumption by each cat in the individual feeding situation during Phase II was: Snowball, the younger female, 29, 14, 21, 17, and 39 grams on days 1 through 5, a daily average of 24 grams; Linda, the older female, 8, 10, 14, 12, and 23 grams, and average of 13 grams per day.

On day 5 of this phase, Linda carried food to her home cage where she consumed it. This was the only instance in either experiment of retrieving to the home cage. This behavior, of course, satisfied one condition of hoarding, but not the condition of accumulation.

Both cats consumed the food in the feeding cages during Phase III, the deprivation phase.

During Phase IV, when the food presented was increased to 150 grams as in Phase II, no hoarding or retrieving occurred.

Table 2

Incidence of Hoarding for Each Cat in Experiment II

Subjects	Phase I ^a	Phase II ^b	Phase III ^c	Phase IV ^d
Snowball	No hoarding	No hoarding	No hoarding	No hoarding
Linda	No hoarding	No hoarding	No hoarding	No hoarding

Note.--Phase I continued for 10 days, Phases II-IV for five days each. Food was presented only during the 30-minute test period during Phases II-IV following 23½ hours deprivation.

^aAd libitum feeding in individual home cages.

^bAdequate food supply in individual home cages.

^cInadequate food supply in individual feeding cages.

^dAdequate food supply in individual feeding cages.

Discussion Experiment II

The same speculations concerning possible reasons for lack of hoarding behavior in Experiment I apply in Experiment II; the deprivation schedule might not have been optimal for hoarding, and the food objects employed might not have released a hoarding response under any conditions. A future study employing several cats under conditions of varying deprivation schedules might prove fruitful, as well as one using live mice or rats as food.

The variable of competition, tested in Experiment I and controlled for in Experiment II, appeared to have no effect on retrieving behavior. In fact, the only cat who retrieved to its home cage was Linda, the older female under conditions of partial isolation. One cat is not a large enough sample upon which to base any conclusions, but her behavior does suggest the possibility of a sex difference in retrieving behavior which might be investigated.

All cats used in both experiments were approximately the same age except Snowball, who was six-and-one-half months younger than the others. She displayed a great deal more restlessness than the others throughout the experiment. She clawed and gnawed at her cage door, paced back and forth between her home and feeding cages, and

knocked the food pan about. This behavior contrasted sharply with that of the older animals, suggesting a study, similar to Hunt's rat study on the effects of early frustration on adult hoarding behavior (1941), in which infant kittens be deprived, then fed ad libitum to maturity and tested for hoarding under deprivation.

To summarize, lines of investigation into the possible induction of hoarding behavior in cats include employing 1) groups of cats strangers to each other under conditons of competition, 2) groups of cats and isolated cats under varying deprivation schedules, 3) comparisons of groups of female cats and male cats, and 4) cats deprived in infancy.

Summary

Two experiments were conducted to determine if cats would hoard to a home cage under conditions of deprivation and competition. One group of three males was tested in a community feeding situation and under 23¹/₂ hours deprivation, and one group of two females was tested under conditions of partial isolation under the same schedule of deprivation.

The results demonstrated a consistent absence of hoarding in the two experiments, leading to an analysis of the possible causes why hoarding did not occur.

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APPENDIX

SOCIAL BEHAVIOR PATTERNS OF CATS UNDER DEPRIVATION

Territoriality

No individual cat appeared to stake out a territory of his own during colony life, although no systematic observations were made to verify this. The cats ate together, and when a strange cat was introduced, the entire colony united in keeping the intruder at bay.

One purpose of Phase I was to encourage the development of territoriality in each individual regarding his own cage. There was no evidence that this had occurred when placed in the test apparatus. Each cat allowed the others to enter his cage at will. Since they had shared the territory of the laboratory, the sharing may have generalized to the test apparatus.

Grooming

Cats typically groom themselves after feeding. The subjects did this the first two days of Phase II, but were never observed doing this thereafter.

In colony life, the cats often lay together and groomed each other. This was not observed at any time during the experiment.

Exploratory Behavior

All three cats exhibited exploratory behavior the first three days of Phase II, each roaming through and sniffing the cages and alleys belonging to the other two animals. William early demonstrated a preference for cage 2 and spent most of the time, when not feeding, in that cage. A and V displayed no preference for any position in the apparatus, but settled in any of the three alleys or remaining cages when not feeding or roaming. A and/or V sometimes joined W in cage 2.

Activity and vocalization

As the experiment progressed, the activity level of the subjects decreased, but it is doubtful that this decrease was due to weakness from deprivation for all the cats played in the laboratory when released each day for the purpose of cleaning the apparatus. They ran about, climbed, and played with the experimenter.

During the first three days of Phase II much exploratory activity was displayed, but most of the movement was confined to returning to CFC to feed briefly after the initial concentrated feeding or to the cage nearest the door when noise was heard outside the laboratory. The subjects also moved to the cage nearest the experimenter when she changed her observation post from time to time.

During the first two days of Phase III the cats became restless again, repeatedly returning to CFC after the food was gone, shifting the feeding dish and floor, occasionally finding crumbs of food. This behavior continued throughout Phase III but with less and less frequency.

During Phases IV and V the cats returned occasionally to the food source to feed briefly after the initial concentrated feeding, but generally rested quietly.

While movement decreased, there was a sharp increase in vocalization as Phase III progressed, but a decrease during Phases IV and V. The usual behavior was for the cat to settle where he could see the experimenter, stare at her, and meow. W was the most vocal of the three, and in one instance meowed for three minutes without pause.

The decrease in activity may have been the result of deprivation, but more probably was due to increased familiarity with the apparatus. The increase in vocalization during Phase III probably was a result of deprivation since there was much less vocalization during the phases when the food supply was adequate.

Play and aggression

Kittens early in life display patterns of behavior which is generally considered play. They stalk each other and almost anything that moves. They pounce on their "prey," sometimes after stalking, sometimes from a concealed posi-

tion. This behavior is observed also in adult cats when playing and when hunting birds and small animals.

Kittens also "wrestle" with each other, biting, kicking, and striking with forepaws. This pattern of behavior also is characteristic of adult cats when playing and fighting. Fighting usually is accompanied by snarls, growls, howls, hisses, and piloerection of tail hairs. These latter behaviors are observed in kittens in the presence of a strange cat, a dog, or other strange stimulus, but seldom when playing together.

All the above described behaviors were observed in the experimental cats during colony life, but the experimenter could not determine the difference between playful and aggressive attacks, although she assumed that most of the behavior was playful since there were few snarls and growls.

During the experiment, striking was the only form of what might be called aggressive behavior, and sometimes was accompanied by snarls.

For purposes of description, striking another cat was considered aggressive, an attack. Striking occurred when two cats met in an alley or cage. One would strike the other, who would respond in kind, and the two would pass on or the one attacked would withdraw. No aggressive behavior whatsoever occurred while the animals fed together, even in Phase III when the food supply was severely limited.

A record of attacks was kept to see if a pattern of

dominance could be determined. During Phase II, V attacked A 8 times, W 7 times, W attacked A and V three times each, and A attacked V 13 times and W twice. Thus the role of aggressor was played by V and A 15 times each, and by W 9 times. V was attacked by the others 16 times, A 11 times, and W 9 times.

During Phase III V attacked A 12 times, W 8 times, A attacked V 9 times and W once, and W attacked V 6 times, A once. The aggressor's role was performed by V 20 times, A 10 times, and W 7 times. V was the victim 15 times, A 13 times, and W 9 times.

No aggressive behavior was displayed during Phase IV.

V struck W twice and A once, A struck V twice, and W was peaceful during Phase V. Thus V was the aggressor 3 times and A twice. V and W were attacked twice, A once.

There were 36 instances of attack during Phase II, 37 during Phase III, none during Phase IV, and 5 during Phase V. However, V became more aggressive during Phase III than during Phase II, attacking 5 more times, while W and A became less aggressive, attacking 2 and 5 times fewer, respectively.

The reasons for the individual differences among the three cats are speculative. They may have been due to differences in temperament, or V may have consumed less food than the others, making his deprivation the most severe.

When an adequate food supply was again presented

during Phases IV and V, the aggressiveness, as indicated above, was greatly reduced.

No conclusions could be drawn concerning a dominance hierarchy as defined by attack behavior.