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SOCIAL FACILITATION IN THE FEEDING OF MALE ALBINO RATS

HARRINGTON - 1952

SOCIAL FACILITATION IN THE FEEDING OF MALE ALBINO RATS

Joyce G. Harrington

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science.

University of Massachusetts, Amherst

June 1, 1952

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INTRODUCTION AND REVIEW OF LITERATURE

INTRODUCTION AND REVIEW OF LITERATURE

Several mechanisms have been used to describe the reactions of people and animals to social stimulus situations. The present study is concerned with one of these mechanisms, social facilitation. Floyd Allport (1, p. 262) refers to social facilitation as "increase of response merely from the sight or sound of others making the same movements." The basic nature of social facilitation as a mechanism of social interaction apart from drives of competition and rivalry has yet to be made clear. Indeed, that social facilitation is different from or independent of competition and rivalry remains to be proven.

Allport's interpretation rests on the assumptions (a) that response-produced cues come to serve as conditioned stimuli evoking the same response and (b) that similar cues produced by other organisms have, via primary stimulus generalization, a similar facilitative effect. Allport specifically disavows the operation of competitive drives or rivalry. His position is that in rivalry the intensification of activity comes from emotional reinforcement and is not the direct effect of the sight or sound of others engaging in similar activity. Katz and Schanck (15), however, use the term to describe increase in performance in

the presence of others regardless of motive. Dashiell (9) is also content to leave open the question of the operation of rivalry or competition in social facilitation.

Studies have been made by Allport (1), Triplett (20), Dashiell (8), and others on social interaction in humans, which have shown definite evidence of the operation of the mechanism of social facilitation. In most of these human studies, efforts to eliminate competitive effects have been made. However, since opportunities for the learning of competitive drives in most human subjects studied by American psychologists are difficult if not impossible to control, the differentiation of the effects in humans of competition and rivalry from those of social facilitation in the absence of these drives can not be clearly made.

Most animal experiments showing definite social facilitation have allowed free and active competition among or between subjects, as contrasted with human studies where control of competition and rivalry has been sought.

Welty (21), in a series of experiments with fish showed that there was a higher level of food consumption when fish ate in groups of varying size than when they ate alone. No attempt to control competition was made in this experiment.

Fischel (12) showed that a hen, though exhibiting

no signs of hunger, was stimulated to begin eating again when in the presence of another hen who was feeding. Bayer (6) extended these observations in the feeding behavior of hens. While he did not systematically vary the number of animals in the facilitative situation, he found that there was a greater increment in feeding behavior when there were three facilitators (hungry animals) and one experimental (satiated) animal than when there were three satiated animals and one hungry animal. Bayer's experiments, again, permitted free competition among subjects.

Bruce (7), in a study of the drinking behavior of albino rats showed that social facilitation was evident when only the winning animal had access to the drinking source, but that there was no significant difference in the time of running to the source of water when both animals had free access to it. Bruce concluded from this that competition might be essential to social facilitation.

Lepley (16) performed two experiments in an attempt to demonstrate social facilitation in the running behavior of albino rats. In one experiment, in which both animals of a pair were rewarded, no significant differences in time of running in a straight alley maze were noted between running alone and running in pairs. In the other experiment, in which only the winner was rewarded, a sig-

nificant increment in speed to the goal box was shown for the paired trials in comparison with the alone trials. Although his experiment failed to demonstrate clearly that rats could be taught to compete in the type of situation prescribed by him, Lepley concluded that the speed of locomotion was susceptible to social facilitation, possibly through the operation of competitive drives but "if competitive behavior was demonstrated, it was not identified". This suggested that further work should be done to indicate the place of competition in social facilitation.

Harlow and Yudin (14) studied social facilitation in the feeding of rhesus monkeys. They used four experimental situations: one with direct competition in which both animals were in one cage with a single food pan; the second, non-competitive in which the animals were in two cages one foot apart, each with his own food pan; the third situation was the same as the second with the addition of a food pan between the two cages which both animals could reach; the last was called a "robber" situation but which was essentially another form of competition, since each animal, although in a separate cage with his own food pan, could reach into the food pan of the other animal. Each situation showed progressively higher feeding activity, but it was not clear whether social facilitation could be

considered to exist in the absence of competition since observations of the general behavior suggested the presence of "envy", which might result from a learned competitive drive, in the so-called non-competitive situations.

The questions to be answered by the present study grew out of the series of experiments reported by Harlow (13). Some of his experiments on social effects in feeding behavior of the rat definitely showed social facilitation with respect to a measure of the amount of food eaten. One of Harlow's experiments, No. 6, was designed to eliminate the competition factor; it was carried out with a single facilitator and a single experimental animal. The facilitator, confined in a small cage with only his head free, was placed in a larger cage with the unrestrained experimental rat. Harlow did not report quantitative results, but stated that whether or not the facilitator could reach and eat the food, the consumption of food by the experimental rat was not affected. Harlow (13) concluded that "The essential condition for the occurrence of social facilitation is the presence of rats unrestrained and actively competing with each other for food." This conclusion should not be generalized, however. Since the facilitator and the experimental animal were not engaged in the same behavior, the experimental situation was not

a situation in which social facilitation, (as defined by Allport and in the next section), could be expected to occur. In view of this fact and the fact that Harlow's data were not reported quantitatively, further study to determine if competition may be eliminated as a necessary factor in social facilitation should be done.

Two other experiments in the same series, No. 4 and No. 5, which were essentially similar to each other in design with the exception of a single variable, the number of facilitators, were compared by Harlow. In experiment No. 4, 20 male albino rats were used in groups of two; in experiment No. 5, nine males were used in groups of three. Results were reported for experiment No. 4, but not for experiment No. 5 since the number of cases was so small. Nevertheless, Harlow stated that the comparison of results from the two experiments did not indicate greater facilitation with two facilitators than with one. Since his statement is supported by only partial data and without a statistical comparison, the conclusion does not seem clear-cut.

The conclusions from these various experiments have suggested that further work should be done to study two aspects of social facilitation. It seems that some aspect of competition may be a necessary condition for

social facilitation to occur, though it is not clear how competition operates at different levels of the animal kingdom or how the number of facilitators may enter into the picture.

STATEMENT OF THE PROBLEM

STATEMENT OF THE PROBLEM

This experiment was designed to answer the following two questions regarding the feeding behavior of male albino rats: (1) Does social facilitation occur in the complete absence of all varieties of competition? (2) If so, is the amount of social facilitation a function of the number of facilitators?

The following statements are presented to clarify the present usage of the terms "social facilitation", "facilitator", and "competition".

1. Social Facilitation - Crawford (8, p. 410) in his review of vertebrate social behavior states that social facilitation usually means "increments in the frequency and intensity of responses already learned by an individual, shown in the presence of other individuals usually engaged in the same behavior." This shall be the meaning of the term as it is used in this report.

2. Facilitator - A facilitator is an individual whose presence is or may be associated with increases in the intensity and/or frequency of the responses of a second individual engaged in the same behavior. The number of facilitators plus the experimental or facilitated animal constitutes the group. The presence of a facilitator is the es-

sential condition which makes possible social facilitation.

3. Competition - In order to understand more clearly what competition is and how it enters into social facilitation, we distinguish two uses of the term: first, conflictive competition, which is observed when two or more individuals are striving to make mutually incompatible responses at the same time and place. It is this kind of competition which has characterized most of the previous experiments, such as those of Harlow (13), Bayer (6), and others in which social facilitation has definitely been observed. The second we may call non-conflictive competition, in which there is no direct interference by any subject with another's responses while work toward the goal is in progress. The actual attainment of goal status remains dichotomous, however, i.e., only one racer can be first, only one animal can eat most, and only one business can have the largest sales. It is the operation of this form of competition which may be the basis of social facilitation as observed in most experiments with humans. Later discussion will develop the idea that non-conflictive competition is probably a learned phenomenon.

In view of this distinction between the two types of competition, this experiment was designed to prevent conflictive competition in the experimental situation and to limit possible learning of non-conflictive competitive

drives by isolating the animals except during the experimental period.

It should be pointed out here that this study was not designed to show the agency through which social facilitation operates or why it occurs. The intent was merely to test the following two hypotheses under the conditions of the experiment:

1. Social facilitation in the feeding of male albino rats operates in the absence of competition.
2. The degree of social facilitation in the feeding of male albino rats is a function of the number of facilitators.

METHODOLOGY

METHODOLOGY

Apparatus and Materials:

1. Non-competitive Group Feeding Box (NCGF Box)

This box (see Fig. 1) was divided into four cubicles by one-quarter inch wire screening. Thus the rats were able to see, hear, and smell each other freely and at the same time were prevented from entering into conflictive competition with each other. Each cubicle was fitted with an individual feeding mechanism, placed in the corners where the four cubicles met to insure maximum stimulation under the existing conditions.

The essential parts of the feeding mechanism were a glass storage tube (a in Fig. 2), a plunger (b in Fig. 2), a delivery tube (c in Fig. 2), a feeding dish (d in Fig. 2), and a treadle bar (e in Fig. 2). By depressing the bar, the rat operated a leverage system which pushed the plunger into the storage tube, forcing a food tablet into the delivery tube, through which it dropped into the feeding dish. When pressure was removed from the bar, a spring returned the plunger to its resting position. The feeding mechanism, so designed as to deliver one tablet of food at a time, required only light pressure to operate, thus minimizing fatigue as a possible variable.

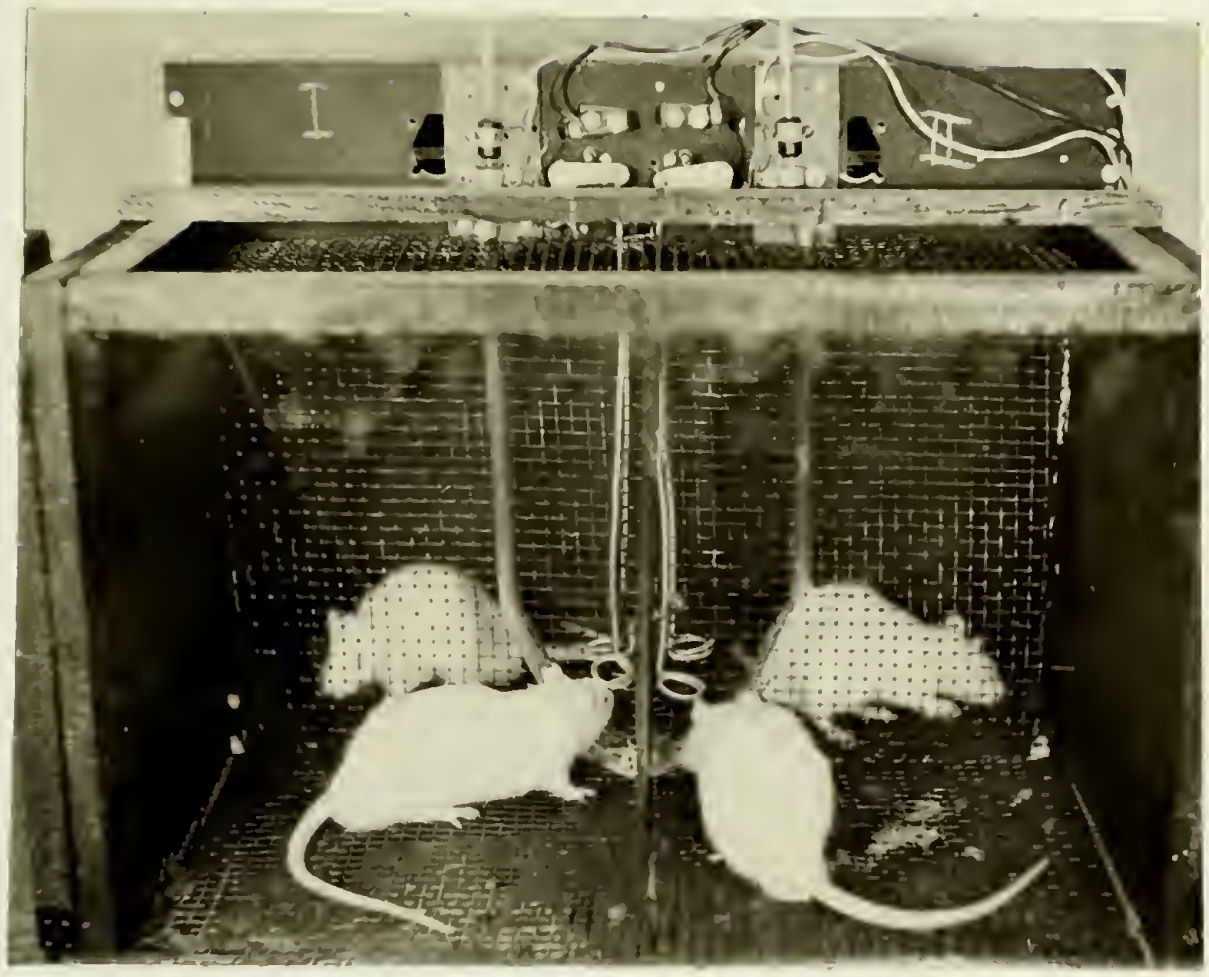

Fig. 1

Non-competitive Group Feeding Box

One side has been replaced by glass to show the design of the box and the rats in place.

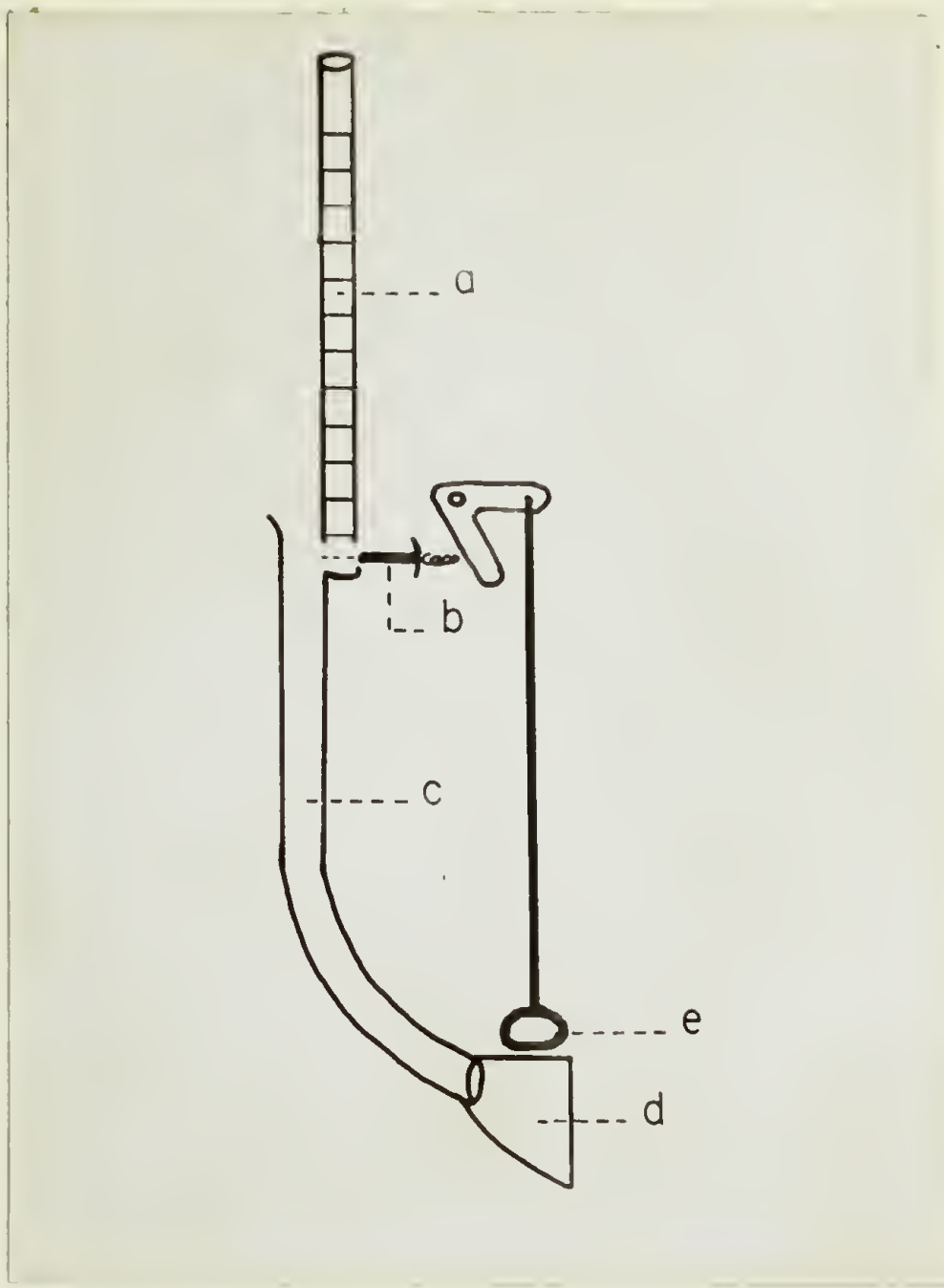

Fig. 2

Diagrammatic Representation of Feeding Mechanism

a. glass storage tube
b. plunger
c. delivery tube
d. feeding dish
e. treadle bar

2. Four living cages shielded on three sides with cardboard blinders.

3. The Lab Chow Tablets, which were used in the NCGF Fox, were approximately 4 mm. in diameter and 3 mm. thick and weighed approximately 42 mg. each.[1]

4. A standard laboratory mash mixture, consisting of Purina Fox Chow mixed with water, was used for supplementary feedings.

Subjects and General Conditions:

Four male albino rats were used in this study. Males, rather than females or a mixed group, were used in order to eliminate variations in activity levels attributable to estrus cycle. The rats were approximately 75 days of age when received.[2]

From the time of their receipt, the rats were isolated in individual living cages which were shielded on three sides by cardboard blinders. This isolation was

---

1. Lab Chow Tablets - Formula

Purina Lab Chow	80%
Bread Flour	10%
Dextrose)	
Dextrin)	10%
Sucrose)	
Acacia)	

2. Age is only approximate, since the rats were purchased according to weight rather than age.

maintained to reduce the possible attachment of secondary reinforcing values to cues from other animals during the feeding in the pre-experimental days and during supplementary feeding on experimental days. In this way, opportunities to learn drives that might produce non-conflictive competition were reduced.

Preliminary Training:

This training consisted of two phases:

Phase I: At 127 days of age, training with the feeding mechanism in the NCGF Box was begun, with each rat being trained individually. Initially this training consisted of two one-half hour periods daily, selected arbitrarily as being of sufficient length to insure learning but not of such length as would induce excessive fatigue. This was continued until the rats were familiar with the NCGF Box as shown by a decline in general exploratory activity and a concentration of activity around the feeding mechanism. The twice daily periods were continued for four days for rats Nos. 1, 3, and 4, and for eight days with rat No. 2 who appeared to learn more slowly. Thereafter the training was reduced to one period of one-half hour daily in order to resemble more closely the experimental period. Preliminary training was carried out for a total of 24 days by which time performance curves, in terms

of the number of tablets contained leveled off. (See Appendix I.)

Phase II: Further preliminary trials to determine the length of the experimental period were carried on in the next four days, again for each rat individually. After 20 hours of food deprivation, each rat was placed in the NCGT Box and allowed to continue in his feeding activity until he was satiated. Mean feeding activity for the four days was computed, in terms of the number of tablets obtained, for each five minute interval. It was found that nine five-minute intervals included for all rats at least two consecutive intervals showing decreased feeding activity. For each rat, the criterion level of decreased feeding activity was set arbitrarily at 50% of the level of activity shown in the peak interval.

Thus the 45 minutes of solitary feeding after 20 hours of deprivation regularly included an extended period of declining activity for all rats. Such a decline when eating alone was desirable so that facilitative effects while eating in the presence of facilitators might possibly be shown in terms of greater duration of a given activity level under conditions of comparatively low primary drive as well as in terms of a generally higher level of feeding activity under other drive conditions.

Design and Procedure of the Main Experiment:

General statement: (1) As set forth in the "Statement of the Problem", this experiment was designed to answer two questions: Does social facilitation operate in the absence of competition? If so, is the degree of social facilitation a function of the number of facilitators?

The main experiment was designed to answer both these questions through a single set of procedures. To allow the results to bear on the first question, the NCGF Box eliminated the possibility of what we have called conflictive competition. The pre-experimental lives of the subjects were controlled so as to minimize the possibility of learning non-conflictive competition or habits of rivalry.

To answer the question as to the influence of the number of facilitators, the experiment provided for the measurement of feeding activity under four conditions: with no facilitators ("alone"), with one facilitator, with two facilitators, and with three facilitators. The experiment was set up in a cycle of 12 days in which each of the above conditions appeared three times. The order in which the conditions appeared was varied systematically to minimize effects of habituation to given group sizes and to

minimize effects of position preferences of each rat in relation to the facilitators. The cycle was repeated three times, providing nine observations in each condition for each subject, and a total of 27 observations in each condition when the data of the subjects were combined (rat No. 4 being excluded from this composite for reasons given on page 24 and in Appendix II).

Detailed statement: The experimental design of each cycle is shown in Table I. The only change in the cycles throughout the experiment was an inversion of the order in cycle two. This cycle was run from day twelve through day one rather than day one through day twelve as was done in cycles one and three.

To illustrate the use of Table I, read opposite day number three. Under rat No. 1, column A shows rat No. 1 in condition F-0 ("alone") and since there are no facilitators, column B shows no entries. For rat No. 2, column A shows rat No. 2 in condition F-2 (with two facilitators, group size of three) and column B shows that the facilitators are rats No. 3 and No. 4, with rat No. 3 opposite No. 2 and rat No. 4 to the right of No. 2. For rat No. 3, column A shows condition F-2 and column B shows that the facilitators are rats No. 2 and No. 4, with rat No. 2 opposite and

TABLE I

Rat No.	1		2		3		4	
Day No.	Col. A	Col. B	Col. A	Col. B	Col. A	Col. B	Col. A	Col. B
1	F-3	2 3 4 R L O	F-3	1 3 4 L O R	F-3	1 2 4 R O L	F-3	1 2 3 O L R
2	F-1	3 L	F-1	4 R	F-1	1 R	F-1	2 L
3	F-0		F-2	3 4 O R	F-2	2 4 O L	F-2	2 3 L R
4	F-0		F-0		F-0		F-0	
5	F-2	3 4 L O	F-0		F-2	1 4 R L	F-2	1 3 O R
6	F-3	2 3 4 R L O	F-3	1 3 4 L O R	F-3	1 2 4 R O L	F-3	1 2 3 O L R
7	F-1	2 R	F-1	1 L	F-1	4 L	F-1	3 R
8	F-2	2 4 R O	F-2	1 4 L R	F-0		F-2	1 2 O L
9	F-0		F-0		F-0		F-0	
10	F-2	2 3 R L	F-2	1 3 L O	F-2	1 2 R O	F-0	
11	F-3	2 3 4 R L O	F-3	1 3 4 L O R	F-3	1 2 4 R O L	F-3	1 2 3 O L R
12	F-1	4 O	F-1	3 O	F-1	2 O	F-1	1 O

EXPERIMENTAL DESIGN OF THE CYCLE

Code:

Column A

F-0 - no facilitators
F-1 - one facilitator
F-2 - two facilitators
F-3 - three facilitators

Column B

Facilitators, indicated by number and their position relative to "experimental" animal, numbered above Columns A and B.
O - opposite
R - right
L - left

rat No. 4 to the left of No. 3. For rat No. 4, column A shows condition F-2 and column B shows that the facilitators are rats No. 2 and No. 3, with rat No. 2 to the left and rat No. 3 to the right of No. 4. The events in any day of the cycle are similarly interpreted, using the code at the bottom of the table.

Throughout the experiment, each time a rat was observed he was considered as an experimental animal; and when working in the presence of other animals he was considered as a facilitator, also. To illustrate this, read opposite day number one in Table I. The condition is F-3 (with three facilitators, a group of four) for all rats. This means that all four rats were in the NCGF Box at the same time. Each was an experimental animal and at the same time acted as a facilitator for the other three animals. In compiling the data from group conditions, each rat in turn was considered as the experimental animal with the other animals considered as facilitators in relation to him.

The position of each rat within the NCGF Box remained constant throughout the experiment. That is, each rat remained in the same cubicle of the NCGF Box for all conditions and for all cycles. This was done in order to eliminate variations in feeding activity attributable to possible differences in difficulty of operating the differ-

ent feeding mechanisms.

The experimental procedure was as follows: For each daily observation, the rats were placed in the MCGF Box after 20 hours of food deprivation and permitted to feed freely. Data were recorded (see insert No. 1 following this page) at the end of each of the nine five-minute experimental intervals.

At the end of the 45 minute experimental period the rats were returned to their living cages. Twenty and one-half hours before each rat was scheduled for his next experimental period, he was given half-rations[3] of wet mash and allowed to feed freely for one-half hour. At the end of the one-half hour all uneaten food was removed from the cages. This limited supplementary feeding was given to maintain an approximately normal diet while at the same time not allowing the rats to become satiated previous to the experimental period. In this way a state of comparatively low primary drive was maintained and the animals were kept in a continuing state of good health.

The rats were allowed to drink water freely, except during the experimental period.

---

3. In pre-training days, it was determined that the rats ate an average of 17 grams dry chow per day. Half-rations for each rat consisted of 8.5 grams of dry Purina Fox Chow prepared as a wet mash with water.

DATA SHEET

Cycle No. _____ Day No. _____ Date _____

Rat #	1				2				3				4			
Condition	F-0	F-1	F-2	F-3	F-0	F-1	F-2	F-3	F-0	F-1	F-2	F-3	F-0	F-1	F-2	F-3
Interval	EC	CF	F		EC	CF	F		EC	CF	F		EC	CF	F	
I																
II																
III																
IV																
V																
VI																
VII																
VIII																
IX																
Total																
Mean																

Remarks:

EC - Cumulative frequency on electrical counters
CF - Cumulative frequency on Tube scales
F - Frequency on tube scales

Scoring and General Treatment of Data:

Feeding behavior was measured in terms of the number of food tablets obtained by each rat in nine consecutive five-minute intervals of a 45 minute experimental period. Readings were taken from the calibrated storage tube at the beginning of the experimental period and at the end of each five-minute interval and the number of tablets obtained computed. Preliminary examination of the results showed that differences in feeding activity were best differentiated on the basis of three fifteen-minute intervals. The data therefore were combined so that the first three consecutive five-minute intervals constituted the first interval, the second three consecutive five-minute intervals made up the second interval, and the last three intervals were combined to form the third interval. The data were then analyzed using mean scores on the three fifteen intervals as the unit of comparison.

Since the problem was concerned with possible differences between feeding behavior in an "alone" condition and in facilitated conditions, the data were analyzed within rats, and not between rats. Animals were not compared with one another. That is, for each rat individually and for the "composite" rat (data from rats 1, 2, and 3 treated as a single animal), performance level in F-0

("alone" condition or no facilitators) was compared with performance level in F-1 (one facilitator), with F-2 (two facilitators), and with F-3 (three facilitators); F-1 was compared with F-2 and F-3; and F-2 was compared with F-3. Data for rat No. 4 were not included in the composite because of his persistent tendencies to avoid work in all group conditions due apparently to having his paws bitten by rat No. 3. (See page 24 and Appendix II.)

RESULTS

RESULTS.

Statistical Procedure and General Discussion of Results.

Data, showing mean feeding activity for each of three 15-minute intervals and for the total 45-minute period, were compiled from the nine trials of each of the four feeding conditions for the individual rats and for a statistical "composite" rat. The data for the statistical "composite" rat were computed from the data for Rats No. 1, 2, and 3, data for Rat No. 4 being excluded from the "composite" rat. These data are presented, under the detailed discussion of the results, in Tables II, IV, VI, and VIII.

A "composite" animal was used in order to increase the number of observations upon which to base a statistical analysis and thus to show more clearly any possible significant trends or patterns of behavior. This use of a composite is possible since the questions to be answered by this study are not concerned with characteristics of a population of rats, but with the effect upon an already observed phenomenon, social facilitation in feeding behavior, of two specific variables, i.e., competition (in this experiment placed at zero value) and variation of the number of animals in the feeding situation. Data from Rat No. 4 were excluded from the "composite" rat because a possible additional vari-

able affecting the data might be present. Early in the experiment this rat developed withdrawal tendencies and generally avoided the work situation in the later intervals of the experimental period as primary drive strength was reduced. This type of behavior was not observed in the two phases of the pre-experimental period. (See Appendix II for explanatory notes on variations in behavior and for the data showing differences in behavior between experimental and pre-experimental periods.) This difference developed on the early days of the experiment when Rat No. 3, by biting the paws of Rat No. 4, interfered with the activity of the latter whenever he climbed the wire partition between the two cubicles.

To test the hypotheses, the data showing mean feeding activity in the different conditions were compared with each other. The "t" test for the significance of a difference in means of related measures was the statistic used to analyze these data. The data and the comparisons made between means will be discussed for each hypothesis separately. It will also be discussed in relation to the activity shown in each of the three intervals as well as in relation to the total activity in order to bring out possible differences in relation to primary drive strength, interval A measuring activity under conditions of relatively

high primary drive strength, interval B measuring activity under conditions of decreased or medium primary drive strength, and interval C measuring activity under conditions of relatively low primary drive strength.

Hypothesis I. Social facilitation in the feeding of male albino rats operates in the absence of competition.

Sixty comparisons were made showing differences between observed means for feeding activity in the "alone" condition and observed means for feeding activity in the three group conditions. Figure 3 summarizes the differences between the observed means which were significant at the 10% level of confidence or better and which are presented in Tables III, V, VII, and IX under the "P" columns. In this figure, no entries are made when differences fail to be significant at the 10% level of confidence or better. Where the differences are significant, they are indicated by a plus sign for a facilitative effect and a minus sign for an inhibitory effect. To exemplify the reading of this figure, for interval C when comparing differences in mean activity levels between conditions F-0 and F-3, the difference for Rat No. 1 is significant at the 1% level of confidence and indicates a facilitative effect, thus in the block under interval C and opposite compared conditions F-0 and F-3, a plus sign has been entered under Rat No. 1 and

SUMMARY OF SIGNIFICANCE OF RESULTS

Hypothesis I

Confidence Levels (%)	Work Intervals A					Work Intervals B					Work Intervals C					Total Period					Conditions Compared
	Rat No. 1	2	3	4	C.	Rat No. 1	2	3	4	C	Rat No. 1	2	3	4	C	Rat No. 1	2	3	4	C	
1																					F – 0 & F – 1
2																					
5																					
10																					
1											+					+					F – 0 & F – 2
2																					
5																					
10																					
1					–						+								–		F – 0 & F – 3
2	–																	–		–	
5				–					–				–			–					
10			–																		

Fig. 3

Comparison of the "alone" condition with the group conditions.

opposite the 1% level of confidence. The difference for Rat No. 4 is significant at the 5% level of confidence and indicates an inhibitory effect, thus a minus sign has been entered in the same block under Rat No. 4 and opposite the 5% level of confidence. For that interval and that comparison, the other rats failed to show significant differences and no other entries are made in that block.

No generally significant facilitative trend is evident from Figure 3. Of the 60 comparisons made, 13 are significant, but only three indicate a facilitative effect, while ten indicate an inhibitory effect. It should be noted that all three instances showing a facilitative effect are shown by a single animal, Rat No. 1, while an inhibitory effect is shown in the activity of all animals. On the basis of interval activity, the first interval shows four instances of an inhibitory effect, the second interval shows one instance of an inhibitory effect, and the third interval shows two instances of a facilitative and one instance of an inhibitory effect. Since those significant differences showing an inhibitory effect occur only in the comparison of the F-3 condition (three facilitators) with the "alone" condition, a discussion of possible factors influencing a decrease in feeding activity in the presence of larger numbers of facilitators will be undertaken later (pages

58 and 63 ff).

Hypothesis II. The degree of social facilitation in the feeding of male albino rats is a function of the number of facilitators.

This study was undertaken with a single experimental design to test both hypotheses, the second hypothesis being contingent upon the first hypothesis and valid only if the first hypothesis is confirmed. Analysis of the data fails to support the first hypothesis, thus a definitive discussion of the second hypothesis is impossible. However, a discussion of the analysis of the data under Hypothesis II reveals a possible trend which may be of further interest, and it will, therefore, be discussed.

Sixty comparisons were made showing differences between observed means for the feeding activity in the three group conditions. Figure 4 summarizes the differences between the observed means which were significant at the 10% level of confidence or better, and which are presented in Tables X, XI, XII, and XIII under the "P" columns. This figure is read in the same way as Figure 3. No significant facilitative trend is evident with an increase in group size. This result is to be expected since Hypothesis I failed to be confirmed and Hypothesis II is contingent upon it. Out of the 60 comparisons, 21 are sig-

SUMMARY OF SIGNIFICANCE OF RESULTS
Hypothesis II

Confidence Levels (%)	Work Intervals A: Rat No. 1	2	3	4	C	B: Rat No. 1	2	3	4	C	C: Rat No. 1	2	3	4	C	Total Period: Rat No. 1	2	3	4	C	Conditions Compared
1																					F - 1
2																					&
5																+				+	F - 2
10																					
1																					F - 1
2			-		-		-													-	&
5																		-	-		F - 3
10	-									-											
1		-			-					-							-	-		-	F - 2
2													-								&
5																-					F - 3
10			-				-	-													

Fig. 4

Comparisons between the three group conditions.

nificant, with two showing a facilitative effect, while 19 show an inhibitory effect with an increase in group size. On the basis of interval activity, the first interval shows six instances of an inhibitory effect, the second interval shows five, and the third interval shows one. Total activity shows two instances of a facilitative effect and seven instances of an inhibitory effect in 15 comparisons. All the inhibitory effects are observed in the comparisons between F-3 and the other two group conditions. The preponderance of instances of an inhibitory effect, almost 50%, suggests the possibility of optimum group size in social facilitation in feeding activity or the introduction of a distraction factor into the feeding situation.

Detailed Discussion of Results.

Hypothesis I. Social facilitation in the feeding of male albino rats operates in the absence of competition.

To interpret the data in terms of this hypothesis, the differences in feeding activity between the "alone" condition and the three group conditions, i.e., with one facilitator, with two facilitators, and with three facilitators, were computed. Each of the three 15-minute intervals and the total 45-minute experimental period are treated separately. Tables II, IV, VI, and VIII present the statistical constants from which the differences were

computed. Figures 5, 6, 7, and 8 show mean activity level from these tables in graphic form. Since differences in mean activity level and their statistical significance is not indicated in these figures, they must be interpreted in conjunction with Tables III, V, VII, and IX which present differences in mean activity, "t"'s, and the significance levels. While many noticeable differences in the figures are not statistically significant, they reflect possible trends in feeding behavior in terms of activity level. In many cases the curves in these figures show only minor differences in activity levels.

In interval A, the first 15-minute period of the 45-minute experimental period, reference to Figure 5, a graphic representation from Table II, shows only two points on the curves indicating an increase in activity and these were associated with comparison of the F-2 condition with the "alone" condition, but further reference to Table III shows that these increases in activity were not significant at the 10% level of confidence or better. Since there were no significant increases in activity for the group conditions as compared with the "alone" condition, the data for the first interval fail to support the first hypothesis. When primary drive strength is still at a relatively high level, then, there is no significant increase in feeding

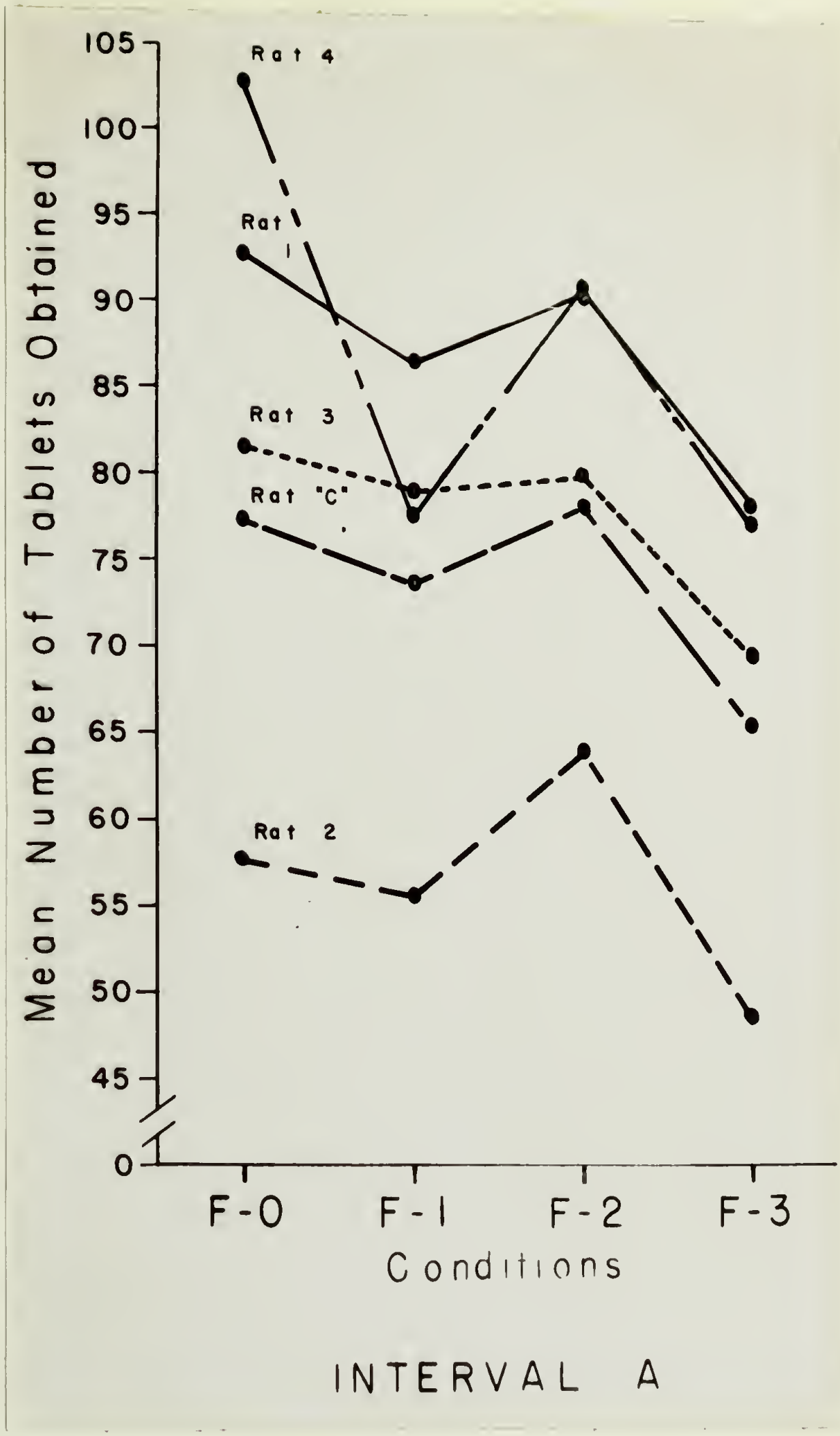

Fig. 5

Comparison of performance levels in the various conditions for the first 15-minute interval.

TABLE II.

Means and Standard Deviations for Interval A. Data from Rats No. 1, 2, 3, 4, and C ("composite" rat).

Rat No.	Condition							
	F-0		F-1		F-2		F-3	
	M	s	M	s	M	s	M	s
1	92.8	6.8	86.6	9.5	90.8	11.7	78.7	11.6
2	57.6	15.4	55.7	13.2	64.1	9.2	48.7	14.1
3	81.6	11.9	79.1	5.8	80.1	10.0	69.8	9.1
4	102.8	10.9	77.7	36.9	91.0	19.4	77.7	22.0
C	77.3	10.7	73.8	8.9	78.3	8.6	65.7	8.8

TABLE III.

Differences between Means, "t's", and Significance Levels[a] of "t's" for data reported in Table II - Hypothesis I.

Rat No.	Conditions Compared								
	F-0 & F-1			F-0 & F-2			F-0 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	- 6.2[c]	1.211		- 2.0	0.378		-14.1	2.944	2%
2	- 1.9	0.312		6.5	0.970		- 8.9	1.118	
3	- 2.5	0.486		- 1.5	0.253		-11.8	2.142	10%
4	-25.1	1.657		-11.8	1.364		-25.1	2.734	5%
C	- 3.5	1.122		1.0	0.305		-11.6	3.324	1%

a. For Rats No. 1, 2, 3, and 4, for 8 d.f., t's of 1.860, 2.306, 2.896 and 3.355 represent differences significant at the 10%, 5%, 2% and 1% levels, respectively. For C (the "composite" rat), for 26 d.f., t's of 1.706, 2.056, 2.479 and 2.779 represent differences significant at the 10%, 5%, 2% and 1% levels, respectively.

b. Probabilities of reported differences being due to chance are less than the figure entered. Vacant spaces in the "P" column indicate probabilities greater than 10%.

c. The minus sign entered before the difference in means indicates that the mean obtained for the "alone" condition was greater than the mean for the group condition compared with it, indicating a decrease in mean feeding activity in the group condition.

activity in the presence of facilitators when competition is absent from the feeding situation.

All five curves in Figure 5 show a downward trend of activity when comparing F-1 (one facilitator) with F-0 ("alone") and when comparing F-3 (three facilitators) with F-0 and three curves show a downward trend when comparing F-2 (two facilitators) with F-0. However, reference to Table III shows that there are only four significant differences showing an inhibitory effect in feeding activity and all these occurred with the comparison of the F-3 condition with the "alone" condition. Rat No. 2 was the only animal failing to show a significant difference. When primary drive strength is still at a relatively high level, there is a significant decrease in feeding activity when the group feeding situation is comprised of four animals.

In interval B, the second 15-minute interval of the 45-minute experimental period, inspection of Figure 6, which represents graphically the means in Table IV, shows that there are five points on the curves indicating an increase in feeding activity for the group conditions as compared with the "alone" condition, but reference to Table V shows that none of these increases are significant at the 10% level of confidence or better. Since there are no instances of a significant facilitative effect, the

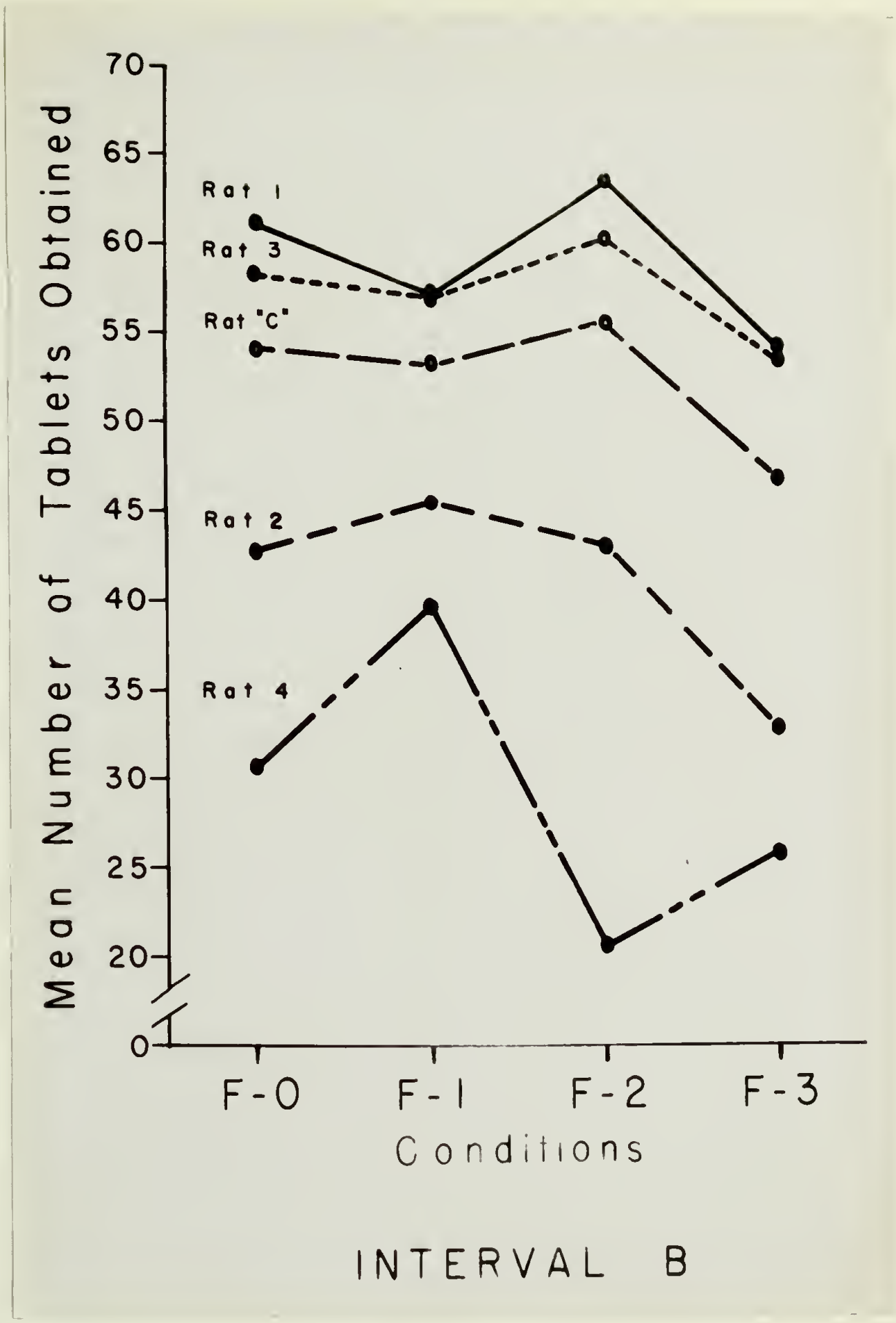

Fig. 6

Comparison of performance levels in the various conditions for the second 1½-minute interval.

TABLE IV.

Means and Standard Deviations for Interval B. Data from Rats No. 1, 2, 3, 4, and C ("composite" rat).

Rat No.	Condition							
	F-0		F-1		F-2		F-3	
	M	s	M	s	M	s	M	s
1	61.1	7.9	57.3	16.8	64.0	10.0	54.8	14.4
2	42.8	12.3	45.6	14.2	43.3	13.1	33.0	12.9
3	58.4	7.7	57.1	4.9	60.7	7.0	54.0	7.2
4	30.6	21.4	39.8	22.1	20.6	14.0	26.0	20.5
C	54.1	6.4	53.3	7.7	56.0	6.2	47.3	6.8

TABLE V.

Differences between Means, "t's", and Significance Levels[a] of "t's" for Data Reported in Table IV - Hypothesis I.

Rat No.	Conditions Compared								
	F-0 & F-1			F-0 & F-2			F-0 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	- 3.5[c]	0.581		2.9	0.617		- 6.3	0.922	
2	2.8	0.364		0.5	0.076		- 9.8	1.578	
3	- 1.3	0.307		2.3	0.813		- 4.4	1.053	
4	9.2	1.033		-10.0	0.905		- 4.6	0.492	
C	- 0.5	0.293		1.9	0.691		- 6.8	2.073	5%

a. See Table III.

b. See Table III.

c. See Table III.

data from the second interval fail to support the first hypothesis. When primary drive strength has been reduced, then there is still no significant increase in feeding activity in the presence of facilitators when competition is absent from the feeding situation.

In Figure 6, a consistent downward trend is shown when comparing F-3 with the "alone" condition but reference to Table V shows that only for the "composite" rat is this decrease in feeding activity significant. Under conditions of reduced primary drive strength, there is one instance of a significant inhibitory effect in feeding activity in the comparison of the F-3 condition with the "alone" condition.

In interval C, the last 15-minute interval of the 45-minute experimental period, reference to Figure 7, a graphic representation of the means in Table VI, shows no generally consistent pattern of either increases or decreases in feeding activity when comparing the "alone" condition with the group conditions. There are eight increases and seven decreases in feeding activity, but there is no consistent pattern of these increases and decreases, no group condition showing all increases or all decreases. Reference to Table VII shows that only three of these differences are significant, two showing a facilitative effect and one showing an inhibitory effect. Rat No. 1 shows differ-

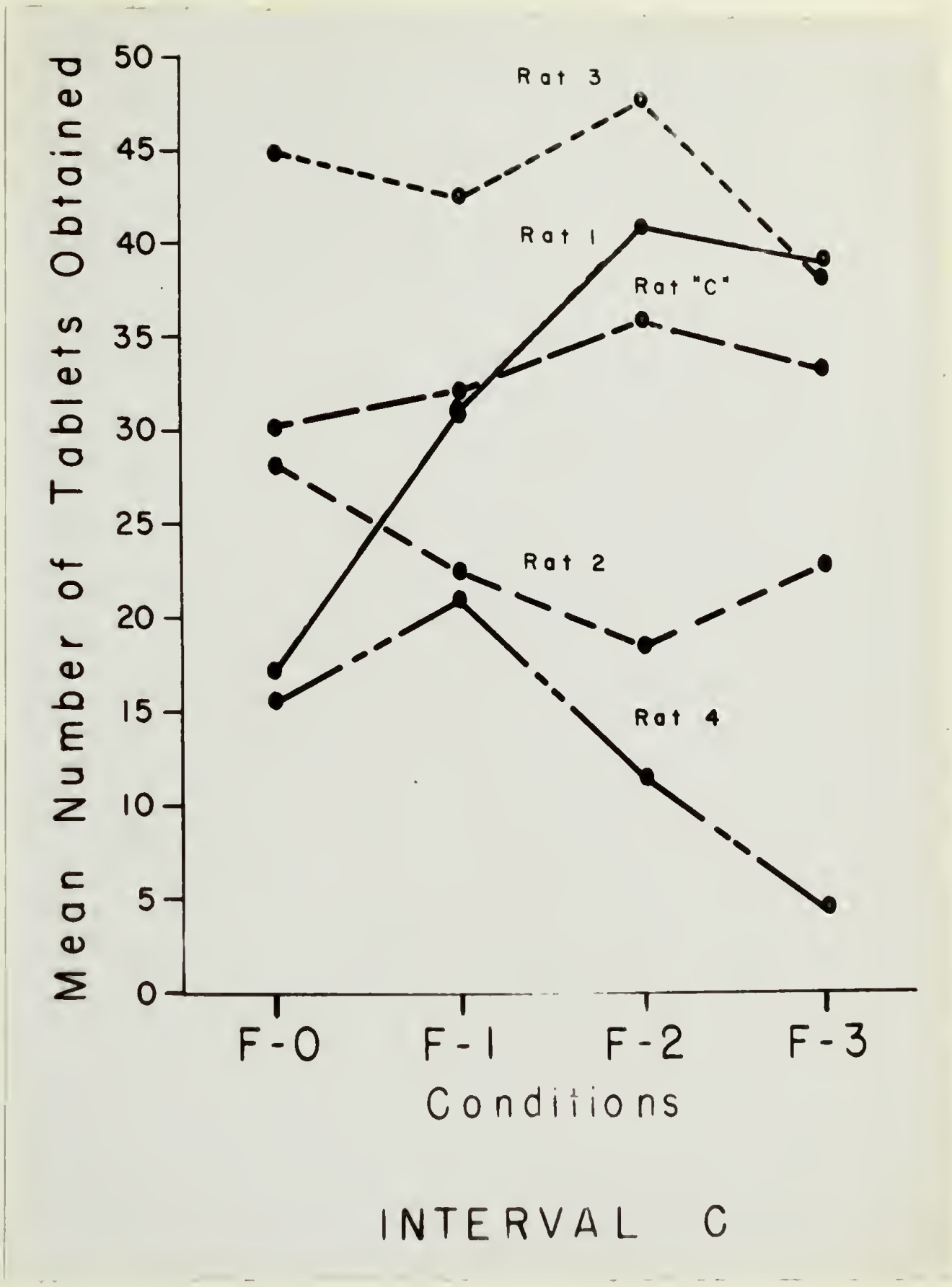

Fig. 7

Comparison of performance levels in the various conditions in the last 15-minute interval.

TABLE VI.

Means and Standard Deviations for Interval C. Data from Rats No. 1, 2, 3, 4, and C ("composite" rat).

Rat No.	Condition							
	F-0		F-1		F-2		F-3	
	M	S	M	S	M	S	M	S
1	17.2	11.5	31.4	17.8	41.2	14.7	39.6	15.7
2	28.3	13.7	22.6	15.5	18.8	10.5	23.2	8.7
3	45.0	8.9	42.8	8.9	48.2	7.4	38.6	7.0
4	15.6	18.9	21.1	31.3	11.6	16.5	4.6	9.3
C	30.2	9.4	32.3	9.5	36.1	8.4	33.8	7.1

TABLE VII.

Differences Between Means, "t's", and Significance Levels[a] of "t's" for Data Reported in Table VI - Hypothesis I.

Rat No.	Conditions Compared								
	F-0 & F-1			F-0 & F-2			F-0 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	14.2	1.736		24.0	3.443	1%	22.4	3.678	1%
2	- 5.7[c]	0.973		- 9.5	1.616		- 5.1	1.200	
3	- 2.2	0.417		3.2	0.852		- 6.4	1.495	
4	5.5	0.439		- 4.0	0.527		-11.0	2.439	5%
C	2.1	0.522		5.9	1.432		3.6	0.952	

a. See Table III.

b. See Table III.

c. See Table III.

ences indicating an increase in feeding activity significant at the 1% level when comparing conditions F-2 and F-3 with the "alone" condition, while Rat No. 4 shows a difference indicating a decrease in feeding activity, significant at the 5% level when comparing the F-3 condition with the "alone" condition. Two instances showing a facilitative effect against one showing an inhibitory effect out of 15 comparisons, lend insufficient support to the first hypothesis. The evidence does not indicate a significant trend of increase in feeding activity in the presence of facilitators when competition is absent from the feeding situation. And since a single instance showing an inhibitory effect as against two instances showing a facilitative effect cannot be considered as evidence of a downward trend, the trend of decreased mean feeding activity observed under conditions of relatively high primary drive strength (interval A) seems to have been arrested under conditions of relatively low primary drive strength.

For the total activity of the 45-minute experimental period, Figure 8, a graphic representation of the means from Table VIII, shows five points on the curves indicating an increase in feeding activity, but reference to Table IX shows that only one of the differences comparing the "alone" condition with the group conditions is a sig-

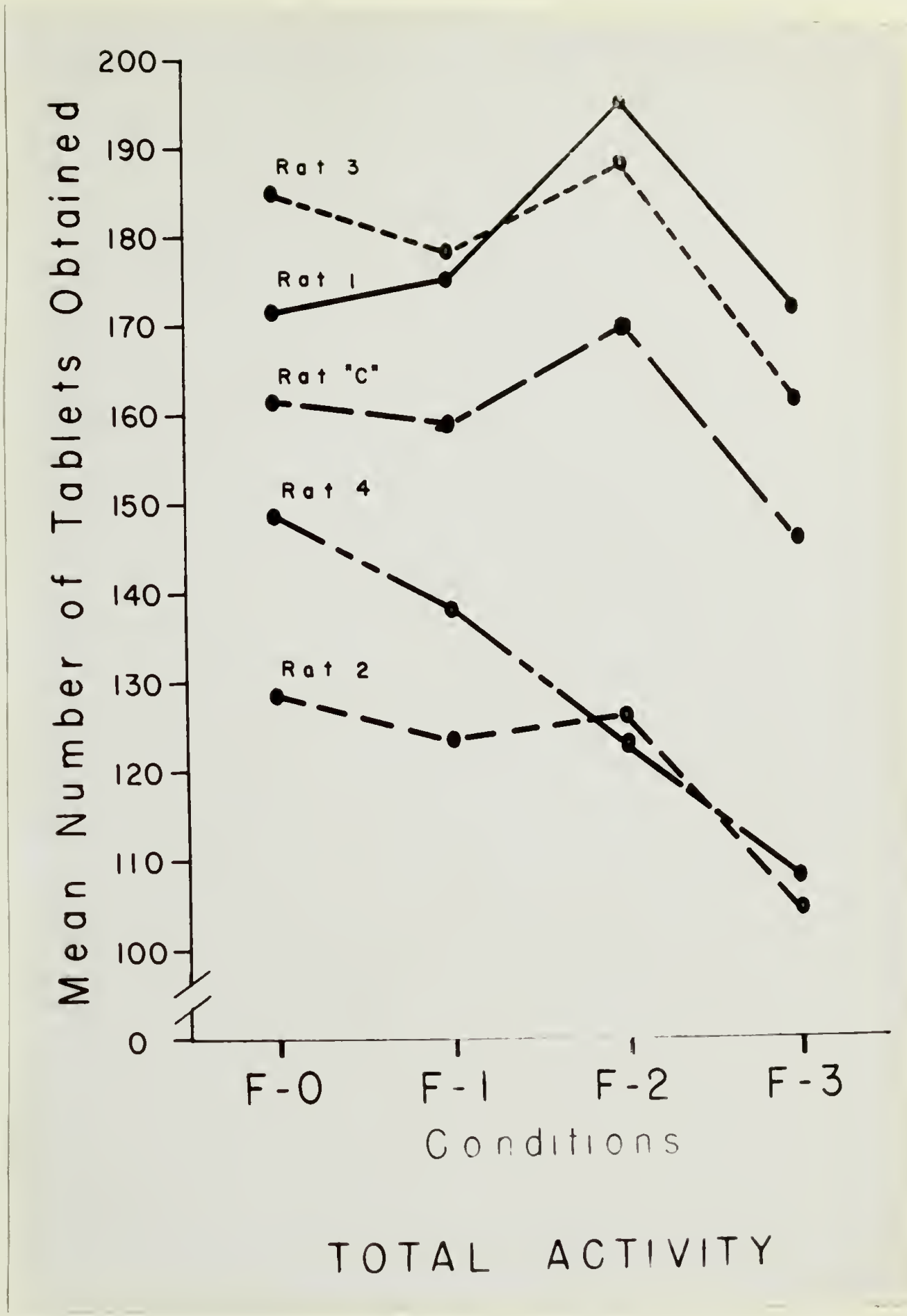

Fig. 4

Comparison of performance levels in the various conditions for the total 45-minute period.

TABLE VIII.

Means and Standard Deviations for Total Activity. Data from Rats No. 1, 2, 3, 4, and C ("composite" rat).

Rat No.	Condition							
	F-0		F-1		F-2		F-3	
	M	s	M	s	M	s	M	s
1	171.1	17.7	175.4	18.2	196.0	10.9	173.0	20.7
2	128.7	22.8	123.8	25.3	126.2	24.1	104.9	21.9
3	185.0	18.9	178.9	15.2	189.0	9.9	162.3	11.5
4	148.9	35.2	138.6	36.6	123.1	36.9	108.2	18.2
C	161.6	17.9	159.3	18.6	170.4	20.4	146.7	1.7

TABLE IX

Differences between Means, "t's", and Significance Levels[a] of "t's" for Data Reported in Table VIII - Hypothesis I.

Rat No.	Conditions Compared								
	F-0 & F-1			F-0 & F-2			F-0 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	4.2	0.380		24.9	3.709	1%	1.9	0.158	
2	- 4.9[c]	0.495		- 2.5	0.177		-23.8	1.904	10%
3	- 6.1	0.589		4.0	0.621		-22.7	2.333	5%
4	-10.3	0.654		-25.8	1.287		-40.7	2.939	2%
C	- 2.3	0.389		8.8	1.499		-14.9	2.303	5%

a. See Table III.

b. See Table III.

c. See Table III.

nificant increase. Rat No. 1 shows an increase significant at the 1% level when comparing the F-2 condition with the "alone" condition. This again is insufficient evidence to support the first hypothesis. Total feeding activity shows no generally significant increase in feeding activity in the presence of facilitators when competition is absent from the feeding situation.

Four curves show differences in feeding activity indicating a decrease when comparing the F-1 condition with the "alone" condition, but since none of these decreases are significant at the 10% level of confidence or better, they do not indicate a significant trend. When comparing the F-3 condition with the "alone" condition, four of the curves show a decrease and reference to Table IX shows that all of these differences are significant. Thus in total activity, when a comparison of conditions of primary drive strength is eliminated, there is a significant decrease in feeding activity in the F-3 condition as compared with the "alone" condition.

Hypothesis II. The degree of social facilitation in the feeding of male albino rats is a function of the number of facilitators.

As stated in the general discussion of results, this study was undertaken with a single experimental design

to answer the two questions "Does social facilitation operate in the absence of competition?" and "If so, is the amount of facilitation a function of the number of facilitators?" The animals were fed alone and in three facilitative conditions, a group of two, a group of three, and a group of four. Mean feeding activity in each of these conditions was computed. Using these data, comparisons between the "alone" condition and the three group conditions were made to test the first hypothesis. Only if social facilitation were found to operate in the absence of competition could comparisons be made between the three group conditions to test the second hypothesis, i.e., to indicate if the degree of facilitation is associated with increasing the size of the group.

Analysis of the data comparing feeding activity in the "alone" condition with feeding activity in the three group conditions failed to reveal any significant trend of increases in feeding activity. Thus in terms of the conditions of this experiment, differences in degree of social facilitation with an increase in the number of facilitators cannot be measured since social facilitation did not occur. However, analysis of the data relevant to the second hypothesis does reveal an interesting trend of a different nature. This same trend was noted in the analysis of the

data relevant to the first hypothesis.

The analysis of the data showing the differences in feeding activity between the three group conditions, i.e., with one facilitator, with two facilitators, and with three facilitators will be discussed separately for each of the three 15-minute intervals and for the total activity of the 45-minute experimental period. Figures 5, 6, 7, and 8, which were used in the discussion of the first hypothesis, will be referred to in this discussion. The first point on the curves in all figures, the F-0 condition, will be ignored as it does not relate to this discussion, we are interested only in a comparison between the various group conditions. Differences in mean activity level between the three group conditions, "t"'s, and the significance levels are presented in Tables X, XI, XII, and XIII.

In interval A, while Figure 5 shows four points of increased activity when comparing the F-2 condition with the F-1 condition, reference to Table X shows that none of these increases are significant at the 10% level of confidence or better. However, in comparing F-3 with F-1 and F-2, a decrease in activity is noted for all rats, except in the comparison of F-3 with F-1 where Rat No. 4 showed no difference in mean activity level. Reference to Table X shows that six of these nine decreases are significant at

TABLE X.

Interval A.

Differences between Means, "t's", and Significant Levels[a] of "t's" for Data Reported in Table II - Hypothesis II.

Rat No.	Conditions Compared								
	F-1 & F-2			F-1 & F-3			F-2 & F-3		
	D	t	p[b]	D	t	p	D	t	p
1	4.3	1.156		- 7.8[c]	2.069	10%	-12.1	1.731	
2	3.4	1.252		- 7.0	0.845		-15.4	3.747	1%
3	1.0	0.224		- 9.3	3.110	2%	-10.3	2.234	10%
4	13.3	1.192		0			-13.3	1.454	
0	4.5	1.415		- 8.1	2.635	2%	-12.6	4.186	1%

a. See Table III.

b. See Table III.

c. The minus sign entered before the difference in means indicates that the mean obtained for the first of the two compared conditions was greater than the mean for the second of the two compared conditions, indicating a decrease in mean feeding activity with an increase in group size.

the 10% level or better, three when comparing F-3 with F-1 and three when comparing F-3 with F-2. Thus it is seen that when group size is increased to four animals as compared with groups of two and of three that there is a significant decrease in activity in a state of relatively high primary drive strength.

In interval B, while Figure 6 shows three points on the curves indicating an increase in activity when comparing F-2 with F-1, reference to Table XI shows that none of these increases are significant at the 10% level or better. In comparing F-3 with F-1 and F-2, Rat No. 4 is the only animal to show an increase in mean feeding activity. Again this increase is not significant. Of the nine decreases in mean activity level depicted in Figure 6, reference to Table XI shows two of the comparisons between F-3 and F-1 and three of the comparisons between F-3 and F-2 are significant at the 10% level of confidence or better. Thus under conditions of medium primary drive strength we find that an increase of group size to four shows a significant trend of decrease in activity level as compared with group size of two or three.

In interval C, while reference to Figure 7 shows that there are seven increases in activity level associated with an increase in group size, reference to Table XII shows

TABLE XI.

Interval 2.

Differences between Means, "t's", and Significance Levels[a] of "t's" for data Reported in Table IV - Hypothesis II.

Rat No.	Conditions Compared								
	F-1 & F-2			F-1 & F-3			F-2 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	6.7	0.922		- 2.5	0.334		- 9.2	1.276	
2	- 2.3	0.376		-12.6	3.247	2%	-10.3	2.024	10%
3	3.6	1.220		- 3.1	1.201		- 6.7	2.204	10%
4	-19.2	1.750		-13.8	1.224		5.4	0.564	
C	2.7	0.825		- 6.0	2.034	10%	- 8.7	2.807	1%

a. See Table III.

b. See Table III.

c. See Table X.

TABLE XII.

Interval C.

Differences between Means, "t's", and Significance Levels[a] of "t's" for Data Reported in Table VI - Hypothesis II.

Rat No.	Conditions Compared								
	F-1 & F-2			F-1 & F-3			F-2 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	9.8	1.283		8.2	0.429		- 1.6	0.226	
2	- 3.8[c]	0.522		0.6	0.104		4.4	0.913	
3	5.4	0.976		- 4.2	0.927		- 9.6	3.111	2[illegible]
4	- 9.5	0.749		-16.5	1.583		- 7.0	1.323	
C	3.8	0.957		1.5	0.475		- 2.3	0.737	

a. See Table III.

b. See Table III.

c. See Table X.

that none of these increases is significant at the 10% level or better. Of the eight decreases shown in Figure 7 associated with an increase in group size, reference to Table XII shows a significant decrease at only one point, the comparison of F-3 with F-2 for Rat No. 3. As in the comparison of the group conditions with the "alone" condition under hypothesis I, the trend evidenced under states of relatively high primary drive strength seems to have been arrested under a condition of relatively low primary drive strength. The single instance showing a significant inhibitory effect cannot be considered evidence of a trend.

For the total activity of the 45-minute experimental period, Figure 8 shows increased activity at four points when comparing the F-2 condition with the F-1 condition and reference to Table XIII shows that two of these increases are significant at the 5% level of confidence, those shown by Rat No. 1 and by the "composite" rat. However, since there are no increases in activity level evident when comparing the F-3 condition with the F-1 and F-2 conditions, there is no generally significant trend of increased activity with increased group size.

Of the decreases in activity level, all but one shown in the comparisons of F-3 with F-1 and F-2, seven are significant at the 5% level or better. The one decrease

TABLE XIII.

Total Activity.

Differences between Means, "t's", and Significance Levels[a] of "t's" for Data Reported in Table VIII - Hypothesis II.

Rat No.	Conditions Compared								
	F-1 & F-2			F-1 & F-3			F-2 & F-3		
	D	t	P[b]	D	t	P	D	t	P
1	20.7	2.760	5%	- 2.3	0.331		-23.0	2.567	5%
2	2.4	0.187		-18.9	1.810		-21.3	3.647	1%
3	10.1	1.347		-16.6	2.582	5%	-26.7	4.776	1%
4	-15.5	0.761		-30.4	2.369	5%	-14.9	1.074	
C	11.1	2.331	5%	-12.6	2.480	2%	-23.7	6.139	1%

a. See Table III.

b. See Table III.

c. See Table X.

shown in the comparison of F-2 with F-1 is not significant. Thus in total activity it is seen that there is a significant trend of decreased activity when, and only when, the group size is increased to four.

Summary of Results.

1. In the 60 comparisons between the "alone" condition and the various group conditions there are three differences in mean feeding activity which are significant at the 10% level of confidence or better and which show an increase. All three of these instances showing a facilitative effect are with Rat No. 1. In contrast with this, there are 10 differences in mean feeding activity significant at the 10% level of confidence or better and which show a decrease. These instances showing an inhibitory effect are evident for all animals. The important conclusion from these data is that practicing a well-learned response in the mere presence of others practicing the same response, in a situation from which competition has been eliminated, does not, under the conditions of this experiment, increase the amount of activity.

2. In the 60 comparisons between the "alone" condition and the three group conditions there are 10 differences in mean feeding activity showing a decrease that are significant at the 10% level of confidence or better. These

instances showing an inhibitory effect are shown only when comparing the F-3 (group of four) condition with the "alone" condition. In the 60 comparisons between the various group conditions, there are 19 differences in mean feeding activity showing a decrease that are significant at the 10% level of confidence or better. Again these instances showing an inhibitory effect are associated only with an increase in group size to four. We do not know why these decrements in activity with an increase in the number of facilitators to three occur, but we may guess that increasing the size of the work group to four may have introduced a distraction factor because of the general habituation of the animals to a solitary existence. Such a distraction factor suggests that there may be an optimum group size for facilitative effects of social groupings.

3. In point (2) above we have noted that there is a decrease in activity level associated with a group size of four as compared with the "alone" condition or the other group conditions. Under Hypothesis I, the downward trend of activity observed in a state of relatively high primary drive strength was arrested in states of medium and low primary drive strength when comparing activity observed in a group of four with activity in the "alone" condition. Under Hypothesis II, the downward trend of activity ob-

served in states of relatively high primary drive strength and medium primary drive strength was arrested in a state of relatively low primary drive strength when comparing activity in a group of four with a group of two and a group of three. Figure 9 shows graphically how the number of significant inhibitory (negative) effects decreases as primary drive strength is reduced when comparing activity levels in a group of four with activity levels in the other group conditions and the "alone" condition. Summing the inhibitory (negative) effects for the "alone" condition, group of two and group of three as compared with a group of four, there are 10 inhibitory effects under conditions of relatively high primary drive strength, H in Figure 9, six inhibitory effects under conditions of medium primary drive strength, M in Figure 9, and under conditions of relatively low primary drive strength, L in Figure 9, there are two inhibitory effects and one facilitative effect, with a net of one negative effect. The dotted line in Figure 9 indicates a hypothetical trend of decreased inhibitory effects and increased facilitative effects with a possible net facilitative effect for activity under conditions of minimal primary drive strength, "0" in Figure 9.

Reference to the summary charts, Figures 3 and 4 for the total activity levels under the total period shows

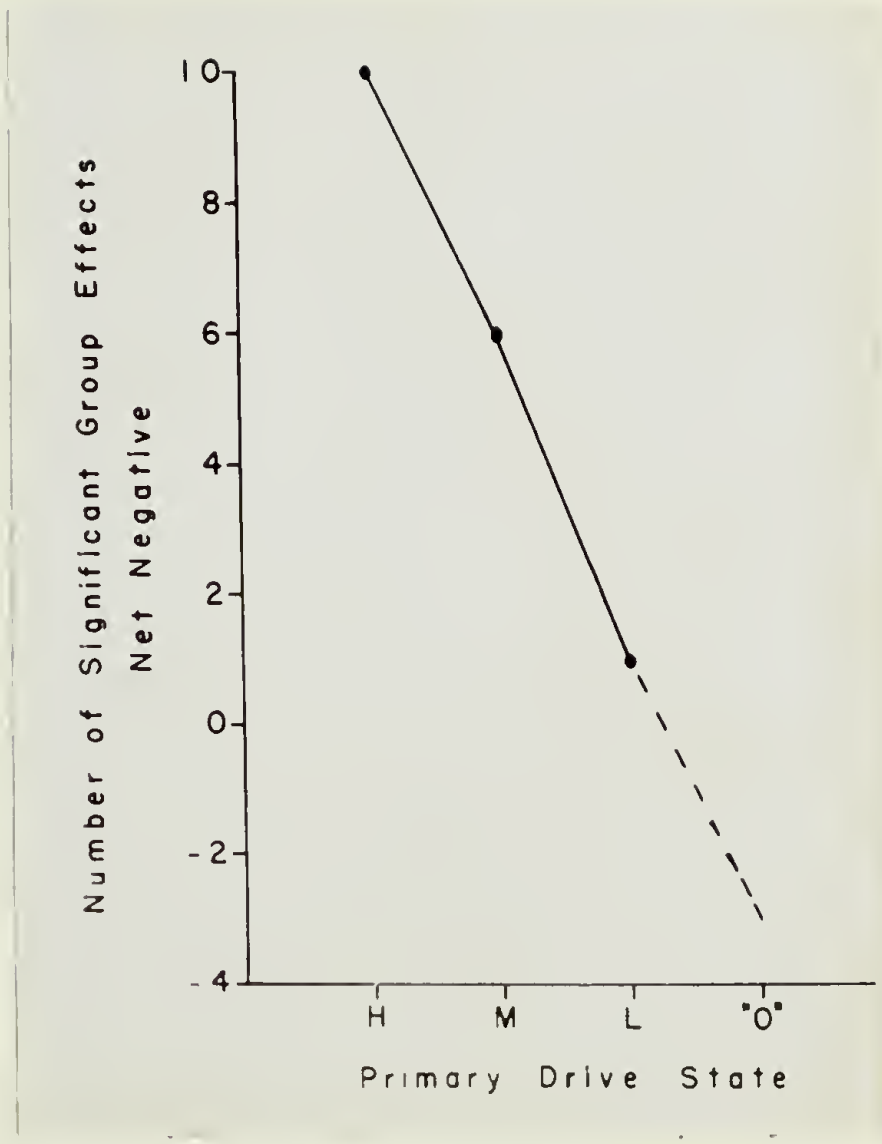

Fig. 9

Showing decrease in number of inhibitory effects as primary drive strength is reduced.

that there is an overall decrease in activity levels when comparing the group of four with the other conditions. However, while feeding in a group of four tends to decrease overall feeding activity, the decrease is observed only in states of relatively high primary drive strength and medium primary drive strength while in a state of relatively low primary drive strength the downward trend of activity level is arrested. The hypothesized minimal drive state suggests that this downward trend might be followed by an upward trend if opportunity for feeding activity were continued beyond the point where satiety is observed in feeding in the "alone" condition.

Social facilitation has not been demonstrated to operate in situations from which competition has been eliminated, but this arresting of a trend of downward fluctuations in activity level related to the number of animals practicing the previously learned response in the presence of one another suggests that the facilitative effects of social groupings, if they occur without the aid of competitive drives, are most likely to occur under conditions of low primary drive strength. If feeding activity were to be continued until primary drive strength has been reduced to a minimal state, it might be found that a facilitative effect or upward trend in feeding activity would

take place with an increase in group size. If this were to occur in the complete absence of competition, it would suggest social facilitation in the Allport (1) sense, i.e., without competition.

DISCUSSION

DISCUSSION

The results definitely fail to support interpretations of social facilitation which do not assume the function of competition in some form. Both forms of competition, conflictive and non-conflictive, have been eliminated in this study and agreement has been found with other negative results obtained under various non-competitive conditions such as those of Bruce (7), Lepley (16), Harlow and Yudin (14), and Harlow (13). The absence of facilitative effects in group feeding behavior may arise from the fact that the cues afforded by the animals practicing the same well-learned response in the presence of one another are not distinctive and have not been attached to the general motivation of feeding behavior. Miller (18) suggests that cues acquire their drive value by acquiring the capacity to elicit an internal response which produces a strong stimulus. Apparently these obscure cues have not been separated from other environmental cues and thus do not give rise to a response which will produce a strong stimulus.

The results do show the presence of inhibitory effects which suggests a distraction factor with an increase in the size of social groupings. These inhibitory

effects were evidenced only when increasing group size to four. Thus, while a distraction factor may be present in social groupings, it may be tentatively suggested that it was only when this factor reached a threshold value in feeding in groups of four as compared with groups of two and three that it was of sufficient intensity to be reflected in the feeding behavior of the animals.

However, further theoretical work and experimentation might profitably be directed toward integrating social facilitation findings with general motivational theory. The possible independent functioning of non-conflictive competition or rivalry as a learned phenomenon has not been examined. Pash (4,5) has suggested that, while organic drive theory offers a basis for the acquisition of hunger drive, feeding behavior in the mature animal results from an acquired hunger drive; the behavior directed toward the acquisition of food is for the most part learned, not innate. Miller and Dollard (19) have advanced the hypothesis that response-produced stimuli, if strong, have drive value and, if distinctive, cue value. A weak stimulus may evoke a response which produces stronger stimulation with drive value. If the connection between the weak stimulus and the response is learned, the drive is said to be acquired. Miller (18) and May (17)

have used this hypothesis as a basis for the study of acquired drives in studies of fear as a response-produced drive that may be attached to environmental cues and provide the basis for new learning and performance. Anderson (2) has hypothesized the externalization of drives; a stimulus object that has been associated with a drive may come to have cue value, arouse the drive, and lead to persistent behavior characteristic of motivated actions. This, with Miller and Dollard's (19) hypothesis that response-produced stimuli can act as cues as well as drives and elicit further motivated behavior, suggests the possible fruitful investigation of acquired competitive drives and thence the operation of non-conflictive competition in social groupings.

Using the paradigm developed in the studies by Miller (18) and May (17), an experiment to investigate the acquisition of competitive drives and thence the operation of non-conflictive competition in social behavior, specifically feeding behavior in social groupings, could be based on the present study. By placing the animals in pairs in a single cubicle of the feeding box where only one of the hungry animals could operate the feeding mechanism and obtain a reward in the form of food, conflictive competition could be induced and thence the acquisition of a com-

petitive drive. After training in the conflictive situation, trained animals and an untrained control group could be used in an experimental design of the type used in this study. It is hypothesized that such an acquired drive might be aroused by cues afforded by the presence and behavior of other animals, thus leading to what has been called in this study non-conflictive competition and providing a basis for social facilitation as generally observed.

In a study to be reported later, similar to the one outlined above, T. R. Vallance and A. O. Sachs have investigated the acquisition of an acquired competitive drive and its operation in feeding behavior in a social situation. Preliminary scanning of the results shows some slight support for the hypothesis of the operation of non-conflictive competition in producing facilitative effects in feeding behavior.

A study of the general basis of the hunger drive and the role of the sense organs in feeding behavior, such as those done by Bash (4,5) and Erickson (11) should be extended and integrated with social facilitation findings. Such a study might point the way to understanding the agency through which social facilitation operates and might suggest why it occurs in feeding behavior. The

results of the present study have suggested that social facilitation is most likely to occur under conditions of relatively low or minimal primary drive state. Since primary drives have stronger response-producing value than acquired drives, it would seem that initial feeding activity would take place in response to the primary drive of hunger, while later feeding activity, after the tensions arousing the primary drive have been reduced, would result from motivation derived from the acquired drive and in response to the environmental cues. Anderson (3) has shown in the rat that the externalization of drive is not complete, and thus it would seem that the effect of an acquired drive would be most clearly differentiated under conditions of minimal primary drive. Thus in any study designed to show the basis of the operation of social facilitation in feeding, the animals should be free to engage in feeding behavior beyond the normal point of satiety. Erickson (11) found that feeding falls off after 10 minutes and he hypothesized that by extending the feeding time (beyond 20 minutes) "the 'social facilitating' factor might be more clearly differentiated, if it were present."

While this discussion has been concerned with the acquisition of competitive drives and their possible

influence upon social behavior in feeding situations with animals, a consideration of the implications of acquired competitive drives and their operation in human behavior in social groupings might be of interest. Further study might reveal that such drives form the basis of the motivation of behavior in social situations which are not clearly conflictive in nature, such as the following:

1. Mr. A decides to go to the movies to escape his wife's nagging. As he approaches the ticket window, he sees another man running to get into line and he begins to run. The original motive, escape from nagging, is replaced by a desire to get in line first. The cues associated with the running of the second individual have apparently aroused an acquired competitive drive which replaced the original drive as a basis of motivation. This is analagous to the Vallance and Sachs experiment with rats, in which the original drive in feeding behavior, hunger, is apparently replaced by an acquired competitive drive aroused by cues afforded by the presence and behavior of others.

2. Mr. Smith has a 1951 Ford, which is useful and economical as a combined family and business car. Mr. Jones, next door, buys a Packard. Mr. Smith

promptly buys a new Cadillac, it strains the family budget, and it is neither as convenient nor as economical as the Ford, but the original motive for owning and operating the smaller car has been replaced by a desire to appear as affluent as Mr. Jones. In communities and neighborhoods, even when social status is relatively assured, there is often such striving to "keep up with the Joneses". The cues afforded by the standard of living and buying habits of the neighbors probably arouse an acquired competitive drive. In this case, the cues afforded by Mr. Jones' purchase of a new Packard have aroused an acquired competitive drive and have motivated Mr. Smith in his purchase of a new Cadillac. This again is analagous to the above mentioned experiment with rats.

However, since human social behavior is complex and the result of many different drives, it is not suggested that any study of acquired competitive drives will provide a complete answer to such problems of human interaction, but will rather point to one possible basis of motivation in competitive situations which are not clearly conflictive in nature.

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APPENDICES

APPENDIX I.

PRELIMINARY TRAINING DATA.

TABLE XIV.

Performance in Terms of the Raw Number of Tablets Obtained During the Preliminary Training (Learning) Period for Rats No. 1, 2, 3, and 4.

Trial No.	Rat Number			
	1	2	3	4
1	4	0	6	1
2	10	0	19	4
3	8	1	9	7
4	11	0	54	14
5	4	0	52	40
6	0	7	97	113
7	38	9	106	143
8	38	25	110	138
9	114	9	113	116
10	75	5	107	168
11	92	20	91	153
12	106	4	103	128
13	119	11	121	149
14	118	22	123	167
15	111	50	118	147
16	115	26	103	156
17	111	54	118	139
18	122	25	120	113
19	114	55	116	136
20	125	80	121	160
21	115	76	117	146
22	141	63	122	151
23	149	85	124	130
24	134	65	114	103
25	150	87	125	128
26	141	86	110	113
27	149	133	124	137
28	144	100	134	140
29		139		
30		103		
31		118		
32		109		

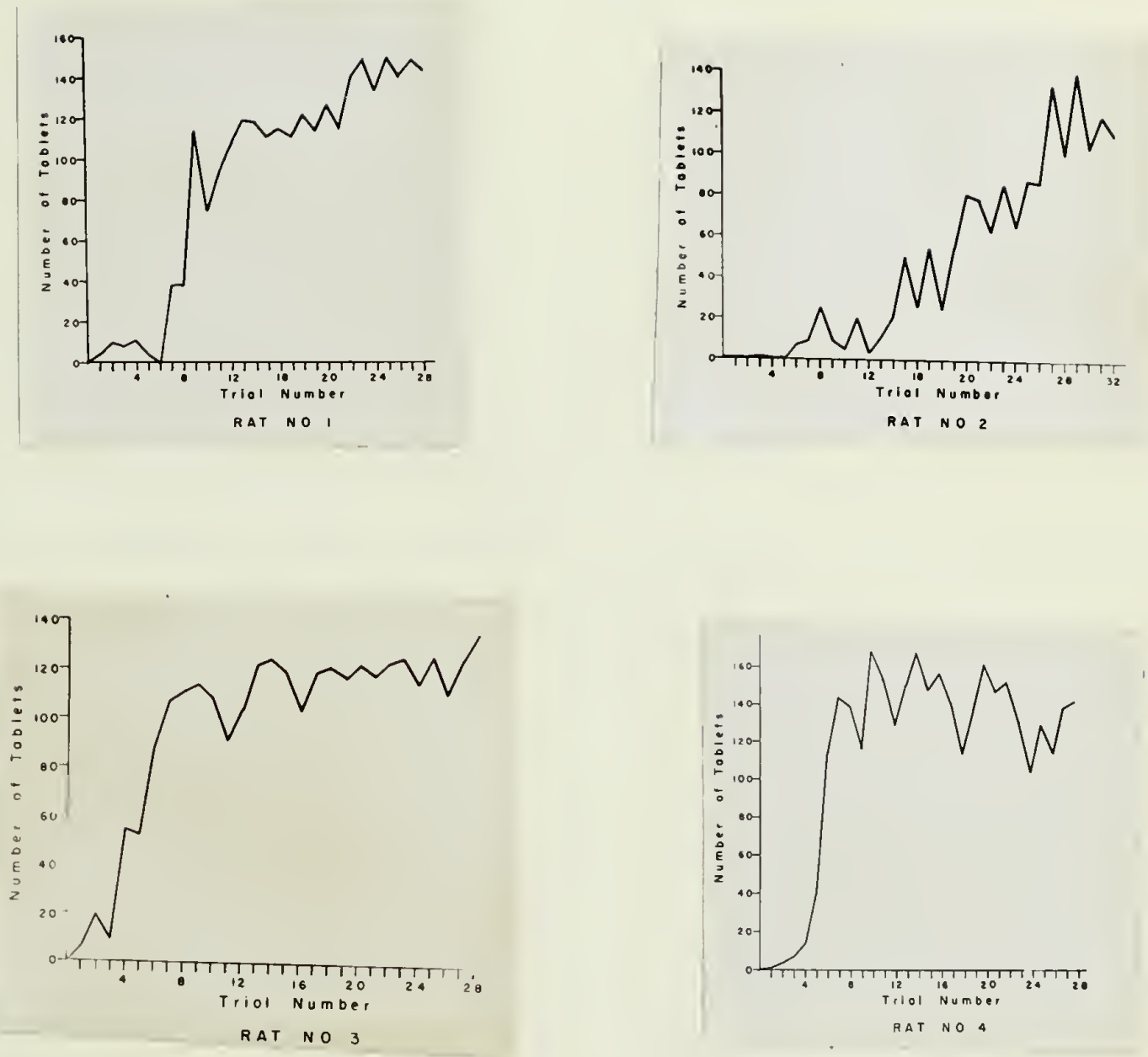

Fig. 10

Performance curves for preliminary training (learning).

APPENDIX II.

RATIONALE FOR THE ELIMINATION OF RAT NO. 4 FROM THE "COMPOSITE" RAT.

In compiling the results, a "composite" animal was used to increase the number of observations on which to base a statistical analysis. Since observation of gross behavior and specific feeding behavior in terms of the number of tablets obtained showed that Rat No. 4's pattern of behavior was altered in the experimental period as compared with the pre-experimental period, and since a variable other than those under investigation might be influencing the behavior of this rat, Rat No. 4 was excluded from the "composite" animal. Rat No. 3 on several occasions attempted to bite the animals in the adjacent cubicles, and while Rat No. 1 did not present much opportunity for this, Rat No. 4 did. He had learned to operate the feeding mechanism by depressing the treadle bar with his forefeet, but seemed to prefer to climb the wire walls separating the cubicles and pull at the top of the connecting rod with his teeth to obtain food tablets in the feeding dish on the floor of the cubicle. On seven separate occasions Rat No. 3 was observed biting the paws of Rat No. 4. This would seem to account for the variations in behavior exhibited by Rat No. 4 and

would introduce another variable into the experimental situation.

Observation of gross aspects of behavior showed a distinct change in Rat No. 4's behavior in the early days of the experimental period. During the pre-experimental phases, the activity of all the rats followed the same general pattern. After the first few days in the learning situation exploratory behavior was not evident and all activity was centered in the corner of the cubicle where the feeding mechanism was located. The rats depressed the bar, obtained a food tablet and ate it before repeating the bar depressing response. But during the experimental period, after being bitten by Rat No. 3, Rat No. 4 no longer concentrated his attention on the feeding mechanism corner. He showed a flurry of feeding activity in the opening minutes of each experimental period, depressing the treadle bar rapidly several times, then eating the several tablets delivered to the feeding dish. This was repeated until his initial hunger appeared to be satisfied. He then withdrew to the corner opposite the feeding mechanism (and away from the rats in the adjacent cubicles) and would remain relatively motionless, only occasionally returning to the feeding mechanism.

This alteration in gross behavior is reflected in the measure of feeding activity, the mean number of tablets obtained. Table XV shows the mean feeding activity observed in Phase II of the pre-experimental period and the mean feeding activity of the experimental period. Comparisons of these two sets of figures for Rats No. 1, 2, and 3 and for the "composite" rat (giving mean activity for these three rats combined), shows that these rats all exhibited a relatively steady decline in feeding activity as primary drive strength was reduced in both the pre-experimental period and the experimental, but that activity was at a slightly higher level in the experimental period. However, for Rat No. 4, while the activity showed a steady decline during the pre-experimental period, the activity level declined sharply at the end of the first interval in the experimental period. While total activity was the same for both periods, in the first interval activity was at a higher level in the experimental period and at a lower level in the last two intervals as compared with the activity levels in the pre-experimental period.

Figure 11 shows graphically the differences in feeding behavior between Rat No. 4 and the other rats, represented by the "composite" rat in this figure. Rat No. 4's activity level decreased much more sharply as

TABLE XV.

Comparing Pre-experimental and Experimental Mean Activity Levels for Rats No. 1, 2, 3, 4, and the "composite" Rat, by Interval and for Total Activity.

Rat No.		Interval A	Interval B	Interval C	Total Activity
1	P[a]	77.8	50.0	33.3	161.1
	X[b]	87.2	59.3	32.4	178.9
2	P	55.5	35.3	5.8	96.6
	X	56.5	41.2	23.2	120.9
3	P	70.8	51.5	35.2	158.5
	X	77.6	57.6	43.6	178.8
4	P	65.3	46.5	18.0	129.8
	X	87.3	29.3	13.2	129.8
"C"	P	68.0	45.6	25.1	138.7
	X	73.8	52.6	33.1	159.5

a. P - pre-experimental mean activity level.

b. X - experimental mean activity level.

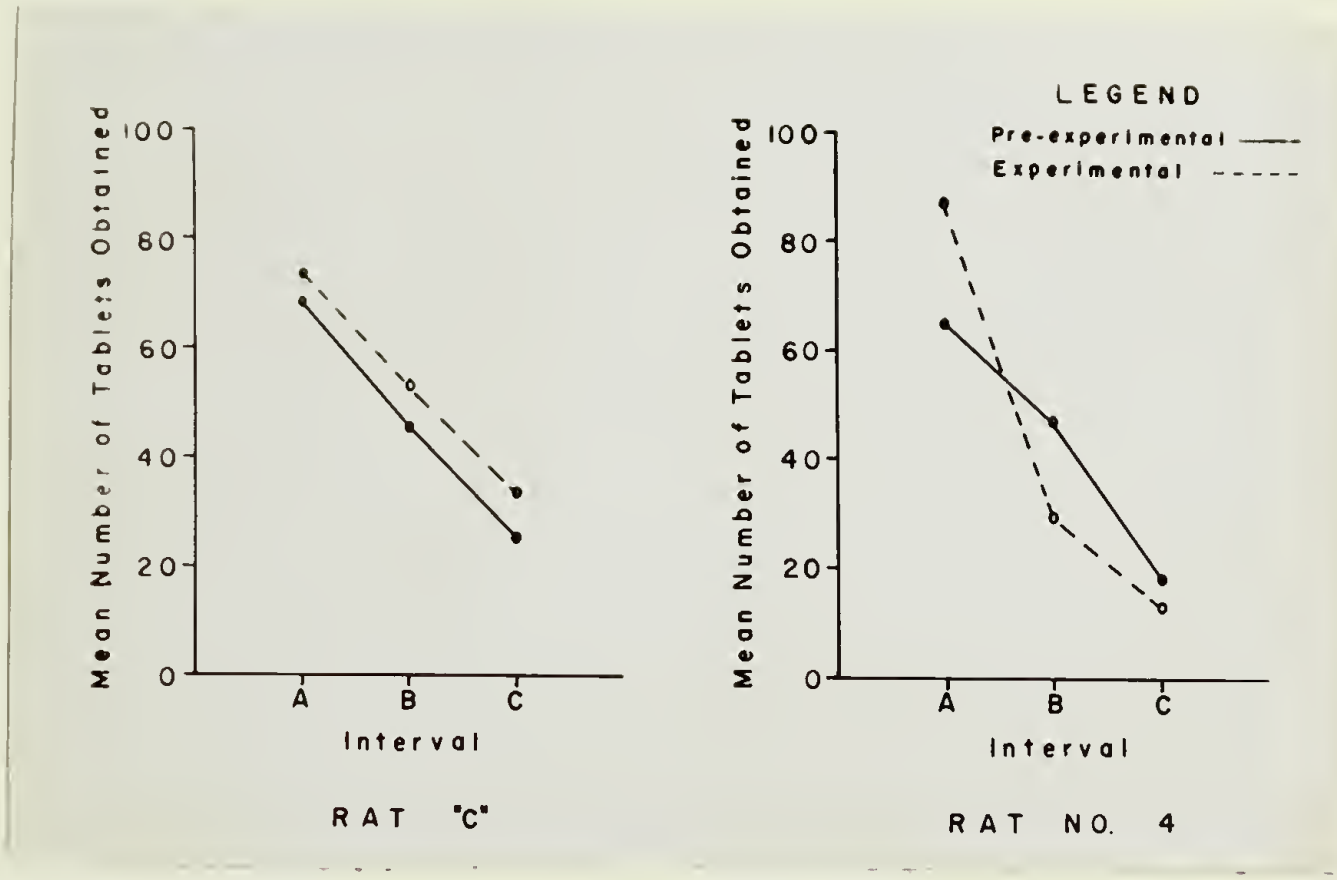

Fig. 11

Performance levels of the pre-experimental period, Phase II, compared with performance levels of the experimental period by 15-minute intervals for rat "C" (composite of Rats No. 1, 2, and 3) and Rat No. 4.

primary drive strength was reduced in the experimental period as compared with the pre-experimental period, while for the other rats the decrease in activity levels as primary drive strength was reduced followed the same pattern in the experimental period as it did in the pre-experimental period.

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