SOME EFFECTS OF SOCIAL STIMULATION ON MAZE RUNNING IN RATS

by

David John Langenes

A Thesis Submitted to the Faculty of the

DEPARTMENT OF PSYCHOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF ARTS

In the Graduate College

1 9 7 2

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: David J. Langenes

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Glenn M. White

GLENN M. WHITE
Assistant Professor of Psychology

August 8, 1972
Date

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Dr. Glenn M. White, thesis director, for his assistance, direction, and interest in this study. Thanks go to Dr. Sigmund Hsiao for his encouragement for research past and present. Appreciation also goes to Dr. Terry C. Daniel for his helpful suggestions on the thesis itself.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ABSTRACT

Evidence of social facilitation effects has been notably inconsistent in investigations using laboratory rats as subjects. The present study was designed to provide a systematic test of Zajonc's arousal hypothesis and to investigate the effects of social stimulation on running and eating behaviors of the white rat. The results indicated that social stimuli resulted in response inhibition, rather than facilitation. It is suggested that the social facilitation paradigm should be expanded to include additional parameters and responses.

INTRODUCTION

Social facilitation has been defined as "any increment of individual activity which results from the presence of another individual" (Crawford 1939, pp. 410-411), and the term has been applied to a wide variety of research involving subjects ranging from humans to cockroaches (Simmel, Hoppe, and Milton 1968). Evidence of social facilitation effects has been notably inconsistent in investigations using laboratory rats as subjects.

Social facilitation effects were reported by Morrison and Hill (1967) in two separate studies. In both studies, rats run in groups approached a goal in which they had previously been shocked more than did rats run individually. At least one study (Lepley 1937a) found that paired rats ran faster in a straight alley for a food reward than rats run individually. On the other hand, a number of investigations have failed to find evidence of social facilitation of maze running in rats (e.g., Lepley 1937b, 1939; Waters 1937). Winslow (1940), using a straight alley, reported evidence of social inhibition in a competitive situation; the "loser" of a pair ran slower than rats run individually. McDaniel and Clayson (1966) investigated the relationship between blood glucose level and the social behavior of rats in a t maze. They concluded that the relationship among drive, metabolism and social arousal is complex and may be mediated by motivational differences related to the type of reinforcement used.

Integrating these results is difficult, since a variety of tasks, procedures, and apparatus were used. Evidently social facilitation occurs only rarely in the maze situation, and the relevant variables are not at all obvious. At this time, as Tolman (1968) has pointed out, further systematic experimentation seems called for.

Zajonc's analysis of social facilitation provides one conceptual framework capable of sponsoring such systematic research. Zajonc (1965, 1968) hypothesized that the mere presence of other organisms results in an increase in the individual's arousal or drive level. This in turn facilitates the response that is dominant at the time of increased drive. While distinguishing between audience effects, involving observers only, and coaction effects, which involve other organisms engaging simultaneously in identical behavior, Zajonc maintains that both situations result in arousal and facilitation of dominant responses (Zajonc 1965, pp. 273-274).

The present study was designed to provide a systematic test of Zajonc's theory and to investigate the effects of social stimulation on running and eating behaviors of the white rat. Four social conditions, designed to allow for both audience and coaction effects, were included. All subjects were first trained and then run in a sequence of five non-social trials, ten social trials, five non-social trials, and a terminal social trial.

If Zajonc's theory is correct, then the subjects would be expected to arrive at the food sooner and eat sooner during the social trials than during the non-social trials. Furthermore, no differences should be observed among the four social conditions. Food consumption should also be greater during the social trials, and no differences in food consumption among the social conditions should obtain.

METHOD

Subjects

Fourteen weeks prior to the experiment, twenty male Wister rats were transferred from the rodent colony room and two group cages to a smaller room and housed individually in small cages. Eight weeks before the experiment was begun, the subjects were introduced to a schedule of reduced food intake. All subjects reached 80% body weight at least four days before the beginning of the experiment and were maintained at this weight throughout the experiment. From the 20 rats, 16 were randomly assigned to one of the four experimental conditions and to receive food reward in either the left or right arm of the maze. The subjects were approximately 420 days old when the experiment was begun.

Apparatus

The apparatus consisted of a t maze with a white plexiglas floor and 1 1/4 cm wire mesh walls. A 3/10 cm (thickness) sheet of clear plexiglas divided into three pieces served as the ceiling. The maze was approximately 19.0 cm wide and 14.0 cm high. The start box was 15.3 cm long and was divided by wooden blocks into two compartments. Galvanized iron guillotine gates were operated from the rear of the maze by draw strings. The maze measured 1.14 m from the guillotine gates to the choice point and 0.89 m from the choice point to the end of each arm. The entire maze was elevated 5.7 cm from the floor of the room by wooden blocks.

The cages which housed the audience animals were 18.4 cm high, 18.1 cm wide, and 14.7 cm deep. They had a wire mesh floor and front and a solid steel back and sides. During the experiment, these cages had cardboard ceilings and were raised to the same height as the maze. A total of 12 audience cages were used, and Figure 1 illustrates their placement around the maze. The audience cages were placed approximately 5.0 cm from the sides of the maze. The apparatus was situated in a laboratory room in which no animals were housed. Throughout the experiment, the maze floor was sprayed with a weak vinegar solution and wiped dry prior to each animal's trial in order to reduce olfactory cues in the runway.

Time to food and time to eat were recorded manually with Standard electric timers calibrated to 0.01 second. Food consumption, when measured, was assessed with a Bosch electric scale calibrated to 0.1 gram.

Experimental Conditions

Table 1 presents an explanation of the four social conditions. The four animals that remained from the original subject pool of 20 were randomly assigned to the four subjects in the coaction-deprived condition and served as their companions during the social trials. Two other animals, chosen on the basis of weight, served as companions in the coaction-nondeprived condition.

Twelve naive male Wister rats approximately 210 days old served as the audience animals.

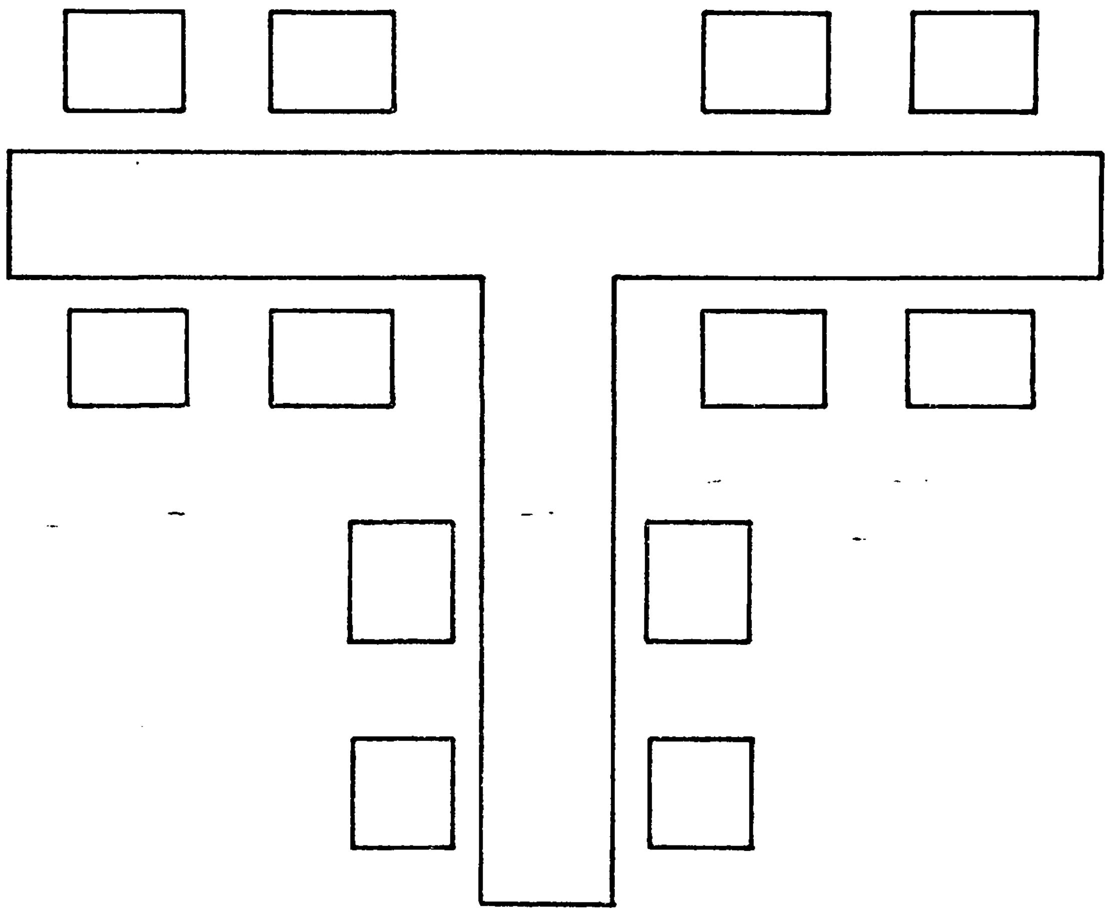

Figure 1. Placement of the audience cages around the maze.

Table 1. Characteristics of the social conditions.

Characteristic	Social Conditions			
	Coaction-Deprived	Coaction-Nondeprived	Audience-Visual	Audience-Nonvisual
Audience rats in place	X	X	X	X
Food-deprived experimental rat in maze	X	X	X	X
Food-deprived companion rat in maze	X			
Nondeprived companion rat in maze		X		
Audience cages covered with opaque cloth				X
Time to food and time to eat recorded	X	X	X	X
Food consumption recorded			X	X

Training

During training, companions and subjects were treated alike. Also, the empty audience cages were kept in place throughout the training period.

After two 10 minute maze-familiarization trials, the animals were placed in the apparatus for 5 minutes per day with food (Purina Rat Chow pellets) available at the appropriate goal. When all animals had reached a criterion of eating within 90 seconds of being released from the start box on two consecutive days, the pre-experimental (non-social) trials were begun. Training lasted for 19 days.

Pre-Experimental Trials

The subjects were run alone in the maze for five consecutive days at the rate of one 5 minute trial per day. Coaction-deprived condition subjects were run first, followed by coaction-nondeprived condition subjects, audience-visual condition subjects, and audience-nonvisual condition subjects, respectively. Subjects within each condition were run in a constant randomly-determined order throughout all trials.

The companion rats were also run alone each day, so that they would maintain familiarity with the maze. After the fifth trial, the companions for the coaction-nondeprived condition were fed in their cages ad lib. All other animals were taken to their cages immediately after each trial and fed the amount necessary to maintain them at 80% body weight.

On days four and five, the audience animals were placed in the audience cages for 15 minutes each day, in order to familiarize them with the apparatus.

Experimental Trials

Ten daily experimental trials were run, with the audience rats in place for all conditions. Each subject in the coation-deprived condition was run with a deprived companion rat, and each subject in the coaction-nondeprived condition was run with a nondeprived companion. In the latter condition, only two companion animals were used, one with the two experimental subjects that received food at the right goal box, and one with the two experimental subjects that received food at the left goal-box. In the audience-visual condition, the subjects were run alone. In the audience-nonvisual condition, subjects were run alone, and the audience cages were covered individually with opaque cloth. Beginning with the second experimental trial, the order in which the conditions were run was determined randomly for each trial.

Post-Experimental Trials

Following the experimental trials, all subjects received one trial per day for five days, with the empty audience cages left in place. All subjects ran the maze alone.

Final Experimental Trial

An additional social trial was run the day following the final post-experimental trial in a manner identical to that of the other ten experimental trials.

RESULTS

Statistical Analysis

Time to food and latency of eating after arriving at food measures were subjected to a 4 (treatments) X 21 (trials) analysis of variance. Also, difference scores of the first social trial (6) minus the final pre-experimental trial (5), the first post-experimental trial (16) minus the preceeding social trial (15), and the final social trial (21) minus the final post-experimental trial (20) were examined as a function of treatments with a 4 X 3 analysis of variance. Social condition and adaptation effects were assessed with post hoc comparisons of the treatments and of the pre-experimental trials (1-5), the initial social trial (6), the first five social trials (6-10), the second five social trials (11-15), the first ten social trials (6-15), all social trials except the first and last one (7-15), the post-experimental trials (16-20), and the final social trial (21), in various combinations. Amount of food consumed data were analyzed with a 2 (treatments) X 21 (trials) analysis of variance, and post hoc comparisons identical to those used on the time to food and latency of eating after arriving at food data were used to assess social condition and adaptation effects.

Time to Food

Table 2 and Figure 2 present the treatment means of time (in seconds) to food for each trial. The subjects did not reach the food sooner on the eleven social trials than they did on the non-social trials.

A Treatment X Trials analysis of variance revealed a significant trials effect (F=2.79, df=20/240, p<.005) and a significant treatments effect (F=3.56, df=3/12, p<.05). The first social trial resulted in response inhibition, with the combined mean for trials 1 through 5 (12.3) differing significantly (p<.10) from the mean of trial 6 (38.1).[1] However, adaptation to the social conditions occurred, since the mean of trial 6 (38.1) differed significantly from the combined mean of trials 7 through 15 (10.0) (p<.10). This adaptation effect was very rapid, since the combined mean of trials 6 through 10 (17.0) did not differ significantly from the combined mean of trials 11 through 15 (8.6). This adaptation effect carried over to the final social trial, since the mean of trial 6 (38.1) differed significantly (p<.01) from the mean of trial 21 (12.4). Evidently the social conditions did not result in a persistent inhibitory effect, since the combined mean of trials 1 through 5 (12.3) did not differ significantly from the combined mean of trials 6 through 10 (17.0) or from the combined mean of trials 6 through 15 (12.8). The termination of the social trials had

---

1. All individual comparisons are based upon the Tukey technique with a criterion of significance of p<.05. All multiple comparisons are based upon the Scheffé technique with a criterion of significance set at p<.10. Due to the conservative nature of the Scheffé procedure, the use of the .10 level of significance is judged to be warranted (Myers 1966, p. 334).

Table 2. Time to food means in seconds.

Condition	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Coaction-deprived	19.00	15.45	19.10	13.20	61.98	52.48	14.28	13.30	30.60	19.78	12.65	14.45	12.10	13.43	9.18	9.75	29.15	11.68	30.78	9.60	25.48
Coaction-nondeprived	7.60	7.28	9.60	8.73	13.68	59.38	24.25	10.88	11.75	7.28	9.25	10.00	8.15	8.45	11.25	12.30	11.35	9.93	35.93	19.63	11.95
Audience-visual	8.13	7.45	6.20	7.98	5.55	21.13	6.80	5.70	7.40	11.93	6.03	7.38	5.30	6.88	5.65	6.98	4.53	5.63	10.13	6.15	4.85
Audience-nonvisual	5.88	9.63	6.20	7.60	5.75	19.25	6.53	6.95	4.78	5.23	9.08	9.63	6.20	7.60	5.75	19.25	6.53	5.38	4.68	5.00	7.23

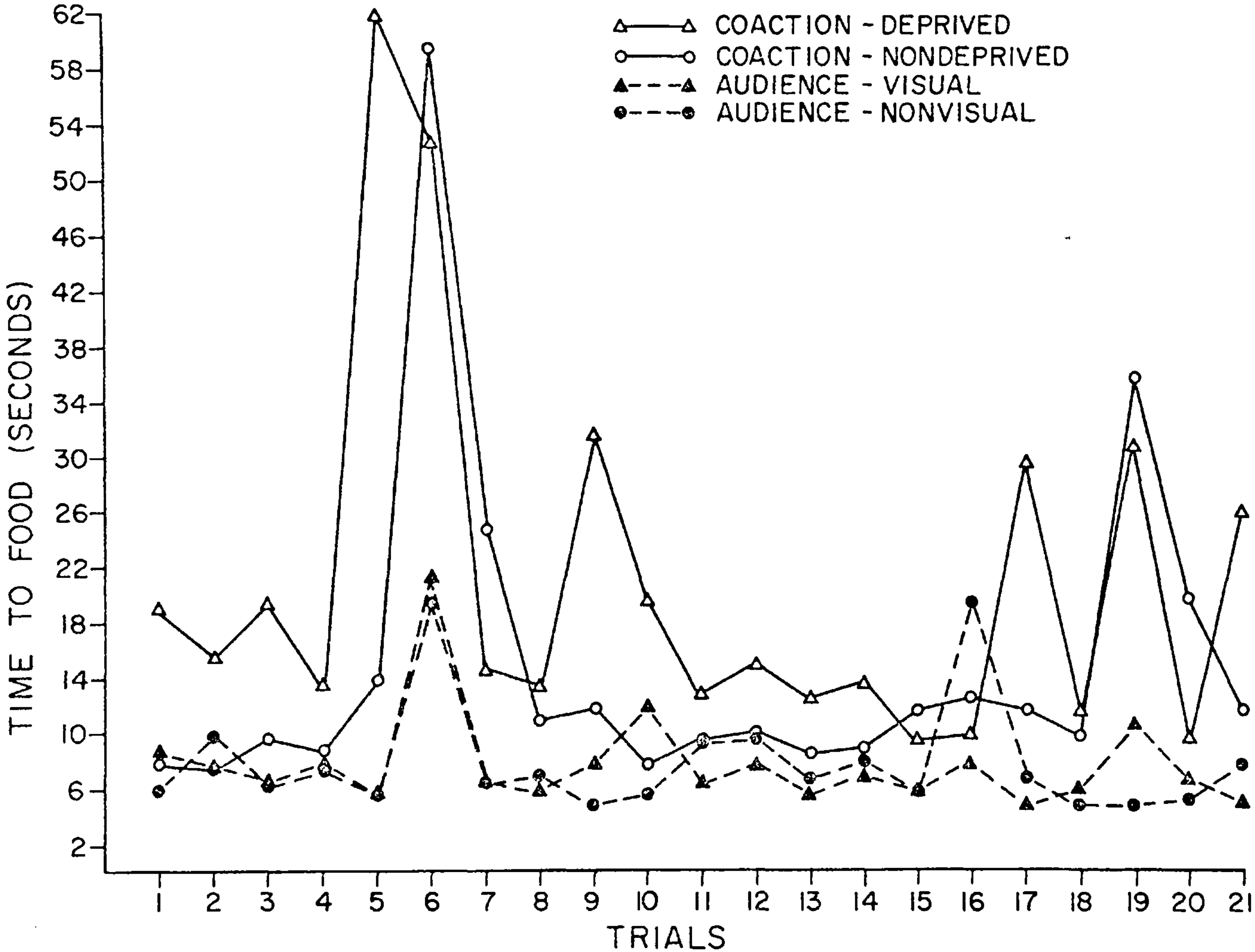

Figure 2. Time to food for each trial for the coaction-deprived, coaction-nondeprived, audience-visual, and audience-nonvisual conditions.

no effect, since neither the combined mean of trials 6 through 15 (12.8) nor the combined mean of trials 11 through 15 (8.6) differed significantly from the combined mean of trials 16 through 20 (18.2). Finally, the initial block of non-social trials ($\bar{X}$=12.8) did not differ significantly from the post-experimental non-social trial block ($\bar{X}$=12.0).

Further analysis of the treatment means did not reveal the exact locus of treatment differences. None of the paired comparisons among the means of the coaction-deprived condition (20.8), the coaction-nondeprived condition (14.7), the audience-visual condition (7.5), and the audience-nonvisual condition (6.9) was significant. The difference between the combined mean of the non-coaction audience conditions (7.2) and the combined mean of the coaction conditions (17.8) was also not significant. However, a trend for subjects in the audience-only conditions to reach the food sooner than did subjects in the coaction conditions was present.

The 4 X 3 analysis of variance performed on the difference scores of trial 6 minus trial 5, trial 16 minus trial 15, and trial 21 minus trial 20, for the time to food data, resulted in non-significant F-ratios (all ps>.05).

<u>Latency of Eating after Arriving at Food</u>

Table 3 and Figure 3 present the treatment means of latency of eating after arriving at food (in seconds) for each trial. The subjects did not begin eating sooner on the social trials than they did on the non-social trials.

Table 3. Latency of eating after arriving at food means in seconds.

Condition	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Coaction-deprived	27.85	24.13	27.55	20.95	48.70	114.08	59.10	17.63	24.50	13.60	58.40	41.13	8.25	38.68	54.15	26.13	42.33	27.68	19.68	21.10	19.85
Coaction-nondeprived	19.45	11.20	15.30	37.13	25.53	117.43	33.63	29.83	45.40	29.63	88.83	37.48	48.00	27.45	13.40	12.30	30.70	29.38	14.30	18.78	59.50
Audience-visual	9.08	29.73	18.08	24.25	12.05	33.63	22.90	21.80	22.60	38.03	13.58	52.05	17.23	31.35	47.55	28.20	18.23	5.88	24.55	14.73	24.13
Audience-nonvisual	18.80	25.05	12.53	6.88	7.35	50.98	20.90	5.63	5.70	7.93	13.53	4.90	14.05	5.18	4.90	5.65	7.35	7.70	6.63	5.68	14.55

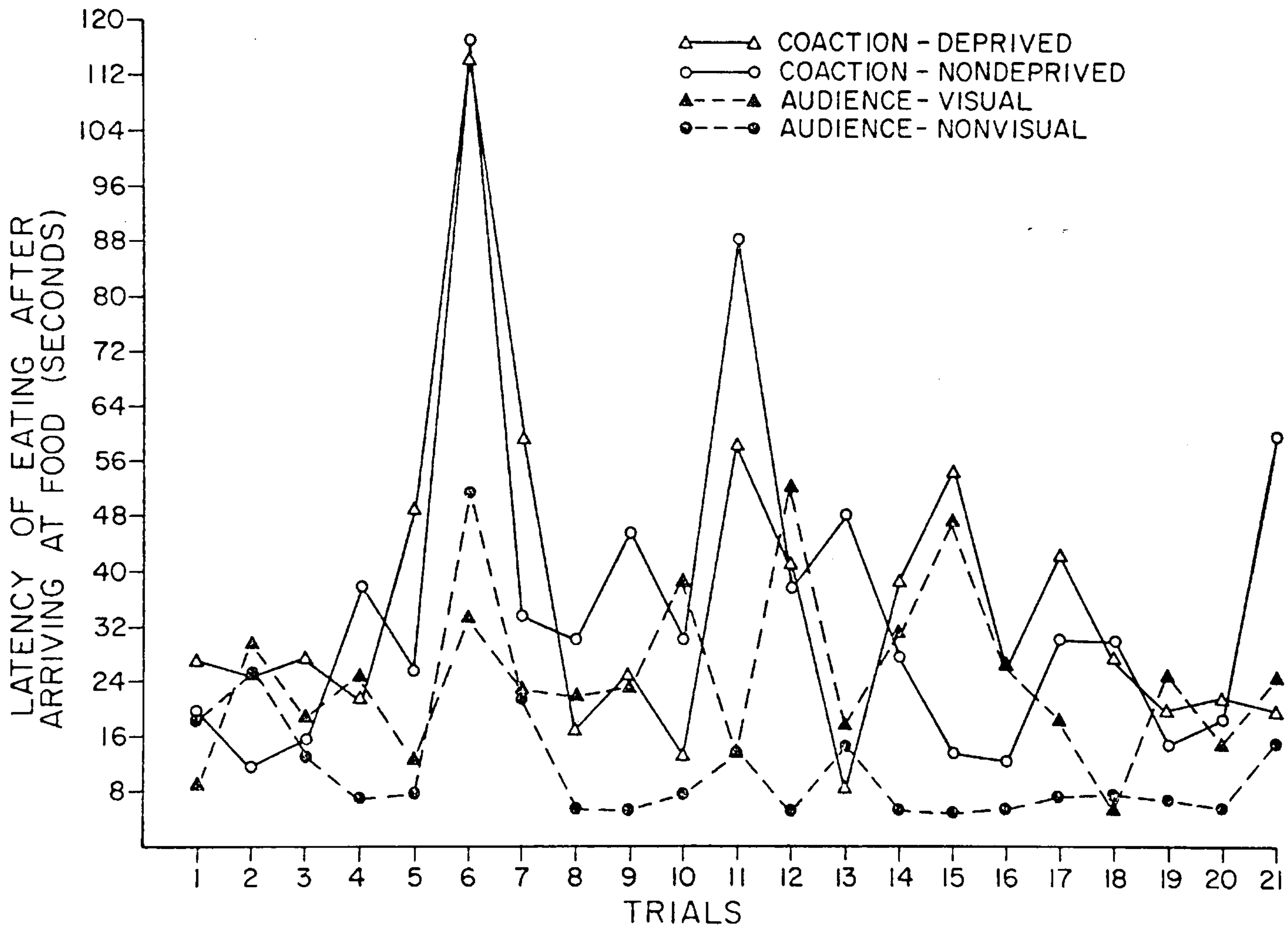

Figure 3. Latency of eating after arriving at food for each trial for the coaction-deprived, coaction-nondeprived, audience-visual, and audience-nonvisual conditions.

The Treatments X Trials analysis of variance revealed a significant trials effect only (F=4.04, df=20/240, p<.005). The first social trial again resulted in response inhibition, with the combined mean for trials 1 through 5 (21.1) differing significantly (p<.10) from the mean for trial 6 (79.0). Adaptation across social trials (trial 6, $\bar{X}$=79.0; trials 7 through 15, $\bar{X}$=28.3) was not significant, although a trend towards adaptation was apparent. Similarly, the difference between the combined mean of trials 6 through 10 (35.7) and the combined mean of trials 11 through 15 (31.0) was not significant. The reintroduction of the social conditions did not produce as great an inhibition effect as resulted from their original introduction, since the difference between the mean of trial 6 (79.0) and the mean of trial 21 (29.5) was significant (p<.01). Other comparisons indicated further that a persistent inhibition effect failed to obtain. The combined mean of trials 1 through 5 (21.1) did not differ significantly from the combined mean of either trials 6 through 15 (33.4) or trials 6 through 10 (35.7). The termination of the social conditions had no effect, since neither the combined mean for trials 6 through 15 (33.4) nor the combined mean for trials 11 through 15 (31.0) differed significantly from the combined mean of trials 16 through 20 (18.3). Finally, the effects of the social conditions did not carry over to the non-social trials, since the difference between the combined mean of trials 1 through 5 (21.1) and the combined mean of trials 16 through 20 (18.3) was not significant.

The 4 X 3 analysis of variance revealed a significant trials differences effect (F=7.09, df=2/24, p<.005). The difference between the mean of trial 6 minus trial 5 (55.6) and the mean of trial 16 minus trial 15 (11.0) was significant ($p<.01$). However, no adaptation effects were evident, because the difference between the mean of trial 6 minus trial 5 (55.6) and the mean of trial 21 minus trial 20 (14.4) was not significant. A significant difference between the mean of trial 16 minus trial 15 (11.9) and the combined mean of trial 6 minus trial 5 and trial 21 minus trial 20 (35.0) obtained ($p<.10$).

Food Consumed

Food consumption was recorded in the audience-visual and audience-nonvisual conditions only. Table 4 and Figure 4 present the treatment means of food consumed (in grams) for each trial.

The Treatments X Trials analysis of variance revealed a significant trials effect (F=1.97, df=20/120, $p<.025$). The appropriate post hoc comparisons were made among the combined mean of trials 1 through 5 (2.2), the mean of trial 6 (1.8), the combined mean of trials 6 through 10 (2.0), the combined mean of trials 11 through 15 (2.1), the combined mean of trials 6 through 15 (2.1), the combined mean of trials 7 through 15 (2.1), the combined mean of trials 16 through 20 (2.2), and the mean of trial 21 (2.2). All post hoc comparisons failed to reach significance, disallowing the discovery of the locus of the significant trials effect. A non-significant trend for subjects to consume more food during the first five trials ($\bar{X}$=2.2) than they did on the first social trial ($\bar{X}$=1.8) should be noted.

Table 4. Food consumed means in grams.

Condition	Trials																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Audience-visual	2.3	2.1	2.3	2.3	2.3	2.1	2.4	2.3	2.4	2.0	2.4	1.9	2.3	2.3	2.0	2.1	2.3	2.3	2.3	2.4	2.3
Audience-nonvisual	1.9	2.0	2.2	2.2	2.1	1.6	1.7	1.9	2.1	1.9	2.0	2.0	2.0	1.9	2.0	2.2	2.0	2.0	2.0	2.1	2.1

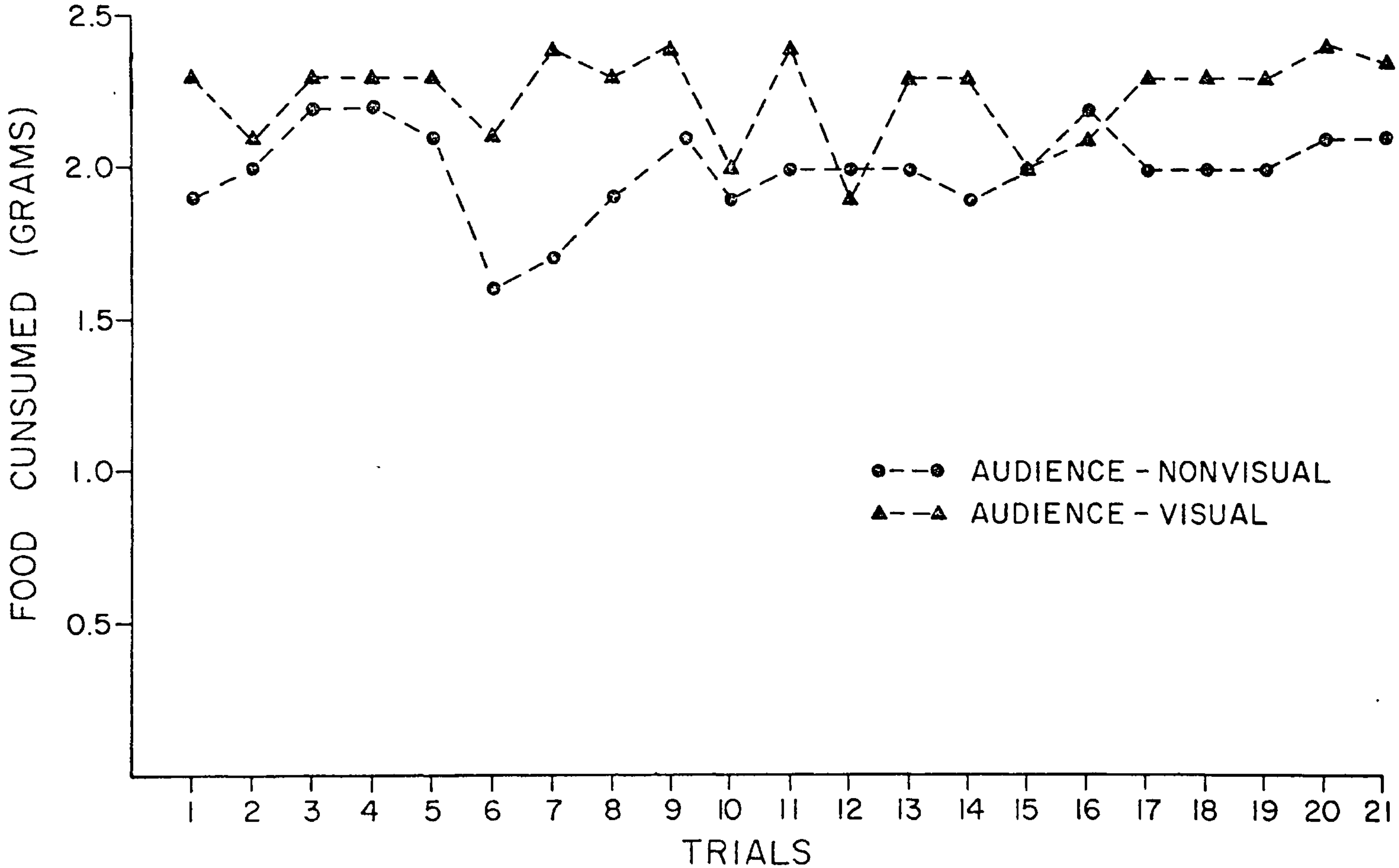

Figure 4. Food consumed for each trial for the audience-visual and audience-nonvisual conditions.

Behavior During the Social Conditions

The coaction conditions made direct interaction between pairs of animals possible. This could have taken any of a number of forms, such as simultaneous running in the maze, mutual sniffing, and fighting. Informal notes taken during the experiment indicate that while occasional brief fights did occur, the predominant behaviors, in addition to eating, were solitary grooming and sniffing of the maze. As the social trials continued, the behavior of the animals, vis a vis each other, seemed to stabilize in the direction of decreased interaction.

Although direct interaction was impossible in the non-coaction audience conditions, nose-to-nose sniffing between the experimental and audience animals was possible. However, the audience animals spent almost all of the time sleeping in the rear of their cages. Meanwhile, the experimental animals spent more time sniffing the maze during the social trials than they did during the non-social trials.

DISCUSSION

The results seem to cast doubt on the generality of Zajonc's theory. The complete lack of any facilitation of performance on any of the three dependent variables as a function of social conditions is not consistent with the predictions that were derived from Zajonc's arousal hypothesis. Where significant differences in the data were found, these differences indicated that the effect of the social conditions was inhibitory. Both time to food and latency of eating after arriving at food measures revealed that this inhibitory effect was greatest on the initial social trial. The time to food data further indicated that subjects adapted rather rapidly to the presence of other animals. Since the subsequent reintroduction of social conditions did not result in response inhibition, this adaptation was evidently a robust phenomenon. This effect could be further explicated by changing the companion animal on every trial. A more basic question is along what dimensions do the responses to novel social and non-social stimuli differ?

The lack of agreement in results across different dependent variables emphasizes the importance of the choice of dependent measures. That social conditions do not effect all responses equally is illustrated by the fact that a clearcut adaptation effect across social trials was evident only on the time to food measure. Tolman (1968, p. 51) has asserted that "whether an increment or decrement is observed depends less on the facilitative mechanism than on the observer's choice of dependent variable." Zajonc (1968, p. 79) has written that "responses are considered dominant if in a given situation they are made with greater frequency, with greater probability and with greater intensity." According to the learning criterion used and observations made while the experiment was in progress, the dependent variables that were used in the present study do qualify as having indexed dominant responses. These results imply that theorists in the field (e.g., Zajonc 1968, Cottrell 1968) will have to be more precise than they have been regarding the classes of behaviors that will be facilitated under specific conditions.

While the results reported here are not consistent with Zajonc's hypothesis, they do not imply that a more general arousal hypothesis is incorrect. It may be that the introduction of social stimuli resulted in a change in the response dominance hierarchy, so that new responses (e.g., those that were facilitated) became dominant. Arousal could have contributed to the intensity of those new dominant responses without affecting eating or running behavior. However, the present design did not provide a test for that possibility.

In his review of the role of the companion, Tolman (1968, p. 51) concluded that decrements in behavior occur when the class of behavior of the companion is different from that of the experimental animal. In the present study, both of the animals in the coaction-deprived condition were running to the food and eating, yet several analyses revealed a decremental effect on certain behaviors. Since the animals were not always behaving alike simultaneously, the interpretation of these results is not clearcut.

There appears to be no theory that would have predicted the facilitation of the behaviors that were facilitated, namely solitary grooming and sniffing of the maze. However, the present experiment did not contain the controls that would be necessary to exclude a theory such as Cottrell's, which maintains that the presence of other organisms results in increased drive if their presence creates anticipations of positive or negative outcomes in the animals of interest (Cottrell 1968, p. 103). Future research using the present design could examine this possibility by controlling for early social experience.

An important aspect of the facilitation paradigm is the fact that additional responses become available to the subject when another organism is present. A social situation may result in the facilitation of some of these new responses, while at the same time inhibiting the frequency and/or strength of some of the non-social responses. Other authors have alluded to this fact (e.g., Tolman 1968), but it has rarely been discussed in research reports, especially if the dependent variables were facilitated. The new responses that obtain as a result of social conditions, and the responses that decrease in frequency as a result of social conditions, should both be specified. Although in the present study new social responses were not prepotent, research that investigates these aspects of the social facilitation paradigm should prove to be profitable.

SUMMARY

White rats were run in a t maze under one of four social conditions that were structured to provide differentially salient social cues. In all social conditions, an audience of cages rats was present. In a coaction-deprived condition, subjects were run with a trained food-deprived rat. Subjects in a coaction-nondeprived condition were run with a trained nondeprived rat. In an audience-visual condition, subjects were run alone. Subjects in an audience-nonvisual condition were run alone with the audience cages covered with opaque cloth. Subjects were trained alone in the maze to criterion, then run alone for five pre-experimental trials, run in the social conditions for ten trials, run alone again for five post-experimental trials, and run for a final trial in the social conditions. Dependent measures were time to food, latency of eating after arriving at food, and, in the audience-only conditions, food consumed. Social facilitation of the dependent measures did not obtain. With respect to time to food, the initial social trial resulted in response inhibition. However, adaptation to the social conditions occurred. The first social trial resulted in response inhibition with respect to latency of eating, also. Informal notes taken during the experiment indicate that the most frequent behaviors during the social trials, in addition to eating, were solitary grooming and sniffing of the maze. Implications for Zajonc's arousal hypothesis are discussed. Also, the importance of

the fact that new responses become available to the subject when another organism is present is emphasized.

LIST OF REFERENCES

Cottrell, N. B. Performance in the presence of other human beings: Mere presence, audience, and affiliation effects. In Simmel, E. C., Hoppe, R. A., and Milton, G. A. (Eds.), Social facilitation and imitative behavior. Boston: Allyn and Bacon, 1968, pp. 91-110.

Crawford, M. P. The social psychology of the vertebrates. Psychological Bulletin, 1939, 36, 407-466.

Lepley, W. M. Competitive behavior in the albino rat. Journal of Experimental Psychology, 1937a, 21, 194-201.

Lepley, W. M. The social facilitation of locomotor behavior in the albino rat. Psychological Bulletin, 1937b, 34, 739.

Lepley, W. M. The social facilitation of locomotor behavior in the albino rat. Journal of Experimental Psychology, 1939, 24, 106-109.

McDaniel, J. W., and Clayson, S. J. Social facilitation of a previously learned response in normal, hypoglycemic, and alloxan diabetic rats. Psychonomic Science, 1966, 6, 499-500.

Morrison, B. J., and Hill, W. F. Socially facilitated reduction of the fear response in rats raised in groups or in isolation. Journal of Comparative and Physiological Psychology, 1967, 63(1), 71-76.

Myers, J. L. Fundamentals of Experimental Design. Boston: Allyn and Bacon, 1966.

Simmel, E. C., Hoppe, R. A., and Milton, G. A. (Eds.). Social facilitation and imitative behavior. Boston: Allyn and Bacon, 1968.

Tolman, C. W. The role of the companion in social facilitation of animal behavior. In Simmel, E. C., Hoppe, R. A., and Milton, G. A. (Eds.), Social facilitation and imitative behavior. Boston: Allyn and Bacon, 1968, pp. 33-54.

Waters, R. H. Group and individual maze learning by the albino rat. Psychological Bulletin, 1937, 34, 739.

Winslow, C. N. A study of experimentally induced competitive behavior in the white rat. Comparative Psychology Monographs, 1940, 15(6), 1-35.

Zajonc, R. B. Social facilitation. *Science*, 1965, *149*, 269-274.

Zajonc, R. B. Social facilitation in cockroaches. In Simmel, E. C., Hoppe, R. A., and Milton, G. A. (Eds.), *Social facilitation and imitative behavior*. Boston: Allyn and Bacon, 1968, pp. 73-87.