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SOCIAL FACILITATION

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Most textbook definitions of social psychology involve considerations about the influence of man upon man, or more generally, of individual upon individual. And most of them - explicitly or implicitly - commit the main efforts of social psychology to the problem of how and why the behavior of one individual influences the behavior of another. The influences of individuals on each others' behavior which are of interest to contemporary social psychologists take on very complex forms. Often they involve vast networks of interdependent influences, such as one finds in studying the process of group decision making, competition, or conformity to a group norm. But the fundamental forms of inter-individual influence are represented by the oldest experimental paradigm of social psychology: social facilitation. This paradigm, dating to Triplett's original experiments on pacing and competition carried out in 1897 (1), examines the influence upon behavior which derives from the sheer presence of other individuals.

Until the late 1930's the interest in social facilitation was quite active, but with the outbreak of World War II, it suddenly died. And it is truly regrettable that it died, because the basic questions about social facilitation--its dynamics and its causes--which are in effect the basic questions of social psychology, were never solved. It is with these questions that the present paper is concerned. We shall first examine past results in this nearly completely abandoned area of research and then suggest a general hypothesis which might explain them.

Research in the area of social facilitation may be classified in terms of two experimental paradigms: audience and co-action effects.

The first experimental paradigm involves the observation of behavior when it occurs in the presence of passive spectators. The second examines behavior when it occurs in the presence of other individuals also engaged in the same activity. We shall consider past literature in these two areas separately.

Audience Effects

Simple motor responses are particularly sensitive to social facilitation effects. In 1925 Travis (2) obtained such effects with the pursuit rotor. This task requires the subject to follow a small revolving target by means of a stylus which he holds in his hand. Each revolution of the target during which the stylus is even momentarily off counts as an error. First Travis trained each subject for several consecutive days until his performance reached a stable level. One day after the conclusion of the training the subject was called to the laboratory, given five trials alone, and then ten trials in the presence of from four to eight upperclassmen and graduate students. They were asked by the experimenter to watch the subject quietly and attentively. Travis found a clear improvement in performance when his subjects were confronted with an audience. Their accuracy on the ten audience trials was greater than on any ten previous trials, including those on which they obtained highest scores.

A considerably greater increment in performance was recently obtained in a somewhat different setting and on a different task (3). Each subject, a National Guard trainee, was placed in a separate booth. He was seated in front of a panel outfitted with a circle of 20 red lamps. The

lamps on this panel light in a clockwise sequence at 12 revolutions per minute. At random intervals one or another light fails to go on in its proper sequence. On the average there are 24 such failures per hour. The subjects' task was to signal whenever a light failed to go on. After 20 minutes of intensive training, followed by a short rest, the National Guard trainees monitored the light panels for a period of 135 minutes. One group of subjects performed their task alone. Another group of subjects were told that from time to time a Lieutenant Colonel or a Master Sargeant would visit them in the booth to observe their performance. These visits actually took place about four times during the course of the experimental session. There was no doubt about the results. The accuracy of the supervised subjects was on the average 34% higher than the accuracy of the trainees working in isolation, and toward the end of the experimental session, the accuracy of the supervised subjects was more than twice as high as that of the subjects working in isolation. Those expecting to be visited by a superior, missed during the last experimental period 20% of the light failures, while those expecting no such visits missed 64%.

Dashiell, who carried out an extensive program of research on social facilitation in the early 1930's, also found considerable increments in performance due to audience effects on such tasks as simple multiplication or word association (4). But, as is the case in many other areas, negative audience effects were also found. In 1933 Pessin asked college students to learn lists of nonsense syllables under two conditions, alone and in the presence of several spectators (5). His subjects required an average of 11.27 trials for the learning of a 7-syllable

list when confronted with an audience. When working alone, they needed only 9.85 trials. The average number of errors made in the audience condition was considerably higher than in the alone condition. In 1931 Husband found that the presence of spectators interferes with the learning of a finger-maze (6), and in 1933 Pessin & Husband confirmed Husband's results. The number of trials which the isolated subjects required to learn the finger-maze was 17.1. Subjects confronted with spectators, however, required 19.1 trials. The average number of errors for the isolated subjects was 33.7 and for those working in the presence of an audience, 40.5.

The results thus far reviewed seem to contradict one another. Using a pursuit rotor task Travis found that audience improves performance. The learning of nonsense syllables, however, seems to be impaired by the presence of an audience, as shown by Pessin's experiment. The picture is further complicated by the fact that when Pessin's subjects were asked, several days later, to recall the nonsense-syllables they previously learned, a reversal was found. The subjects recalling the lists in presence of spectators did considerably better than those recalling them alone. But the learning of a finger-maze seems to be inhibited by the presence of spectators, as shown by Pessin and Husband and by Husband, while performance on a vigilance task improves when carried out under surveillance of a superior.

There is just one, rather subtle, consistency in the above results. It would appear that the emission of well-learned responses is facilitated, while the acquisition of new responses is impaired. To put the statement in conventional psychological language, performance is

facilitated and learning impaired by the presence of spectators.

Let us re-formulate this tentative generalization so that new features of the problem are placed into focus. During the early stages of learning, especially of the type involved in social facilitation studies, the subject's responses are mostly the wrong ones. A person learning a finger-maze, a person learning a list of nonsense syllables, emits during the early stages of training more wrong responses than right ones. Most learning experiments continue until he ceases to make mistakes - until his performance is perfect. It may be said therefore, that during training it is primarily the wrong responses which are dominant and strong; they are the ones which have the highest probability of occurrence. But after the individual has mastered the task, necessarily correct responses gain ascendency in his task-relevant behavioral repertoire. Now they are the ones which are more probable or, in other words, dominant. Our tentative generalization may now be simplified: audience enhances the emission of dominant responses. If the dominant responses are the correct ones, as is the case upon achieving mastery, the presence of an audience will be of benefit to the individual. But if they are mostly wrong, as is the case in the early stages of learning, then the presence of an audience will equally enhance them, therefore preventing and postponing the emission of correct responses.

There is a class of psychological processes which are known to enhance the emission of dominant responses. They are subsumed under the concepts of drive, arousal, and activation (8). If one can show that the presence of an audience has arousal consequences for the subject, we would be a step further in trying to arrange social facilitation results

into a little neater package. But let us first consider another set of experimental findings.

Co-action Effects

The experimental paradigm of co-action is somewhat more complex than the one involved in the study of audience effects. Here we observe individuals, all engaged in the same activity, at the same time, and in full view of each other. One of the clearest effects of co-action is found in eating behavior. It is well known that animals simply eat more when in the presence of others. For instance, Bayer had chickens eat from a pile of wheat to their full satisfaction (9). He waited some time to be absolutely sure that his subject would eat no more, and then brought in a companion chicken who had not eaten for 24 hours. Upon the introduction of the hungry co-actor, the apparently sated chicken ate 67% additional grain. In an extensive study of social facilitation effects among albino rats, Harlow found dramatic increments in their eating behavior (10). In one of his experiments, for instance, the animals, taken shortly after weaning, were matched in pairs for weight. They were then fed alone and in pairs on alternate days. Figure 1 shows his results. It is clear that considerably more food was consumed

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Insert Figure 1 about here
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by the animals when they were in pairs than when fed alone. James (11), too, found very clear evidence of increased eating among puppies fed in groups. The implications for those dieting are obvious.

Perhaps the most dramatic effect of co-action is reported by Chen (12). Chen observed groups of ants working alone, in groups of two and

groups of three. For each ant observations were made under the following conditions. The first experimental session consisted of placing the ants in a bottle filled half way with sandy soil. The ant was observed for a period of six hours. The time at which nest-building began was noted, and the earth excavated by each insect was carefully weighed. Two days afterwards the same animals were placed in freshly filled bottles in pairs, and the same observations again made. A few days later the ants were observed working in groups of three, again for a period of six hours. Finally, a few days after the triad test, nest building was observed for ants in isolation. Figure 2 shows some of Chen's data.

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Insert Figure 2 about here
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There is absolutely no question that the amount of work accomplished increases markedly in the presence of another ant. In all pairs, except one, the presence of a companion increases output by a factor of at least two. The effect of coaction on the latency of the nest-building was equally dramatic. Solitary ants begin working on the nest in 192 minutes, on the average. Groups of two have a latency of only 28 minutes. The effects observed by Chen were limited to the immediate situation, and seemed to have no lasting consequences for the ants. In comparison with the first phase during which the ants worked in isolation, the last experimental session, also devoted to the observing of solitary work, showed no differences.

There is no reason why Chen's findings could not be embraced by the generalization just proposed. Nest-building is a response which Chen's ants have fully mastered. Certainly, it is something that a mature ant

needn't learn. And the generalization simply holds that the presence of others enhances the emission of dominant and well developed responses.

If the process which is involved in audience effects is also involved in coaction effects, then learning should suffer in the presence of other learners. Let us examine some literature in this field. Klopfer (13) observed greenfinches - in isolation and in heterosexual pairs - which were learning to discriminate between palatable and unpalatable food sources. And, as one may by now suspect, his birds learned this discrimination task considerably more efficiently when working alone. I must hasten to add that the subjects' sexual interests cannot be held responsible for the impaired learning of the paired birds. Allee and Masure using Australian parakeets obtained the same result for homosexual pairs, as well, (14). The speed of learning was considerably greater for the isolated birds than for the paired birds, regardless of whether the birds were of the same sex or of the opposite sex.

Similar results are found with cockroaches. Gates and Allee (15) compared cockroaches learning a maze, in isolation, in groups of two, and in groups of three. An E-shaped maze was used by these authors. Its three runways, made of galvanized sheetmetal, were suspended in a pan of

Insert Figure 3 about here

water. At the end of the center runway was a dark bottle into which the photophobic cockroaches could escape from the noxious light. The results, computed in terms of time to reach the bottle, are shown in Figure 3.

Insert Figure 3 about here

It is clear from the data that the solitary cockroaches required considerably less time to learn the maze than the grouped animals. There is

nothing in the report indicating that the animals were knocking each other off the runways. The authors note that the group situation produced inhibition, adding, however, that "The nature of these inhibiting forces is speculative, but the fact of some sort of group interference is obvious. The presence of other roaches did not operate to change greatly the movements to different parts of the maze, but did result in increased time per trial. The roaches tended to go to the corner or end of the runway and remain there a longer time when another roach was present than when alone; the other roach was a distracting stimulus" (p.357).

The experiments on social facilitation performed by Floyd Allport in 1920 and continued by Dashiell in 1930, (16) both using human subjects, are the ones best known. Allport's subjects worked either in separate cubicles or sitting around a common table. When working in isolation, they did the various tasks at the same time, and were monitored by common time signals. Allport did everything possible to reduce the tendency to compete. The subjects were told that the results of their tests would not be compared with each other, that they would not be shown to other staff members, and they themselves should refrain from any such comparisons.

Among the tasks used were: chain word association, vowel cancellation, reversible perspective, multiplication, problem-solving, and judgments of odors and weights. The results of his experiments are well-known: in all but the problem-solving and judgments test, performance was better in groups than in the alone condition. Let us confront these results with our generalization. Word-association

multiplication, the cancellation of vowels, and the reversal of the perceived orientation of an ambiguous figure, all involve responses which are well established. Either they are responses which are very well learned, or which are under a very strong influence of the stimulus, as in the word-association task in the reversible perspective test. The problem-solving test consists of true and false syllogisms, and the subjects are asked to identify the nature of the errors. In contrast to the other tests, it does not involve well-learned responses. On the contrary, the probability of wrong responses on tasks of this sort is rather high, i.e., wrong responses are dominant. Moreover, there is only one correct answer to each syllogism, but the incorrect response tendencies which each of them prompts are many. Therefore, the generalization proposed in the previous section can again be applied: if presence of others raises the probability of dominant responses and, if strong (and many) incorrect response tendencies prevail, then the presence of others can only be detrimental to performance. The results of the judgment tests have little bearing on the present argument, since we have no accuracy figures to evaluate performance. The data reported only show that the presence of others was associated with the avoidance of extreme judgments.

In 1928 Travis (17), whose work on pursuit rotor we have already noted, repeated a part of Allport's experiment using the chain word-association method. In contrast to Allport's results, Travis found that the presence of others decreased performance. The number of associations given by his subjects was greater when they worked in isolation. It is very significant, however, that Travis used stutterers as his subjects. In a way, stuttering is a manifestation of a struggle between conflicting response tendencies, all of which are strong and all of which compete for the privilege of emission. The stutterer, momentarily hung up in

the middle of a sentence, waits for the correct response to reach full ascendancy. He stammers because other competing tendencies are dominant at that very moment. To the extent that the verbal habits of a stutterer are characterized by conflicting response tendencies, it is reasonable to assume that the presence of others, by enhancing each of them, simply heightens his conflict. Performance is thus impaired.

Avoidance Learning

There are two experiments on the learning of avoidance responses, which compare a solitary and a coacting situation. One used rats, the other humans.

Let us first consider the results of the rat experiment (18). A number of albino rats, all litter mates, were deprived of water for a period of 48 hours. The apparatus consisted of a box containing a dish of drinking water. The floor of the box was made of a metal grille wired to one pole of an electric circuit. A wire inserted in the water dish was connected to the other pole of the circuit. Thirsty rats were placed in the box alone and in groups of three. They were allowed to drink for a period of 5 seconds with the circuit open. Following this period the shock circuit remained closed, and each time the rat touched the water he received a painful shock. Observations were made on the number of times rats approached the water dish. The results of this experiment by Rasmussen showed that the solitary rats learned to avoid the dish considerably sooner than the grouped animals. When in groups of three, the rats attempted to drink twice as often as the solitary rats, and necessarily suffered considerably more shock than the solitary subjects.

Let us examine Rasmussen's results somewhat closer. There are two critical responses involved: drinking, and avoiding touching water. They are clearly incompatible. But drinking is the dominant response, and like eating or any other dominant response, it is enhanced by the presence of others. The animal is therefore prevented, by the effects deriving from the presence of others, from acquiring the appropriate avoidance response.

The second study in this vein is quite recent, and was carried out by Ader and Tatum (19). These authors devised the following situation with which they confronted their subjects, all medical students. As in some other studies, they were observed either alone or in pairs. The subject or a pair of subjects, is brought to the room and seated at a table, which is equipped with a red button. Electrodes are attached to the subjects' calfs, by means of which electric shock can be administered. They are all told on arrival that they will be "...taken to another room, seated in a chair, and that electrodes would be attached to their leg. They were instructed not to get up from the chair, nor touch the electrodes. They were also asked not to smoke or vocalize, and were told that the experimenter would be in the next room." (p. 357). And that is all they are told. After the electrodes are attached, the experimenter simply leaves the room. From now on the subject would receive a 1/2 sec. of electric shock every 10 sec.unless he presses the red button. Each press of the button delays the shock by 10 sec. Thus, if he is to avoid shock, he must press the button at least once every 10 sec. It should be noted that no information was given to the subjects about the function of the button, or about the purpose of the experiment.

No essential differences are introduced when subjects are brought in pairs. Both are then seated at the table, and both become parts of the shock circuit. The response of either subject delays the shock for both. The avoidance response is considered to have been acquired when the subject received less than six shocks in a period of five minutes. Ader and Tatum report that the isolated students required on the average 11 min. 35 sec. to reach this criterion of learning. Of the twelve pairs which participated in the experiment, only two reached this criterion of learning at all. One of them required 46 min. 40 sec.; the other, 68 min. 40 sec. These authors offer no explanation for their curious results. But there is no reason why we should not treat them in terms of the generalization proposed above. We are dealing here with a learning task, and the fact that the subjects are learning to avoid shock by pressing a red button doesn't introduce particular problems. They are confronted with an ambiguous task, and told nothing about the button. Pressing the button is simply not the dominant response in this situation. Escaping, however, is. Ader and Tatum report that eight of the 36 subjects walked out in the middle of the experiment.

There are experiments showing that learning is facilitated by the presence of other learners (20). But none employs the coaction paradigm in its pure form. That paradigm involves the presence of others, but it involves nothing else. It requires that these others be not able to provide the subject with cues or information as to appropriate behavior. If other learners can supply the observed individual with such cues, we deal not with the problem of coaction, but with the problem of imitation or vicarious learning. In all these experiments, as far as I can tell, it was possible for the subjects to observe the critical responses of other subjects, and to determine when they were correct and incorrect.

The Presence of Others as a Source of Arousal

The results I have discussed thus far lead to one generalization and to one hypothesis. The generalization which organizes these results is that the presence of others, as spectators or as coactors, enhances the emission of dominant responses. We also know from extensive research literature that arousal, activation, or drive all have as a consequence the enhancement of dominant responses (21). We now need to examine the hypothesis that the presence of others increases the individual's general arousal or drive level.

The evidence which bears on the relationship between the presence of others and arousal is, unfortunately, only indirect. But there is some very suggestive evidence in one area of research. One of the more reliable indicators of general arousal and drive state is the activity of the endocrine systems in general, and of the adrenal cortex in particular. Adrenocortical functions are extremely sensitive to changes in emotional arousal, and it has been known for some time that organisms subjected to prolonged stress are likely to manifest substantial adrenocortical hypertrophy (22). Recent work (23) has shown that the main biochemical component of the adrenocortical output is hydrocortisone (17-hydroxycorticosterone). Psychiatric patients characterized by anxiety states, for instance, show elevated levels of plasma hydrocortisone (24). Mason, Brady, and Sidman (25) have recently trained monkeys to lever-press for food and have given these animals unavoidable electric shocks, all preceded by warning signals. This procedure led to elevated hydrocortisone levels, which returned to normal within one hour after the experimental session. This "anxiety" reaction can apparently be attenuated if the animal is given repeated doses of reserpine one day

before the experimental session (26). Sidman's conditioned avoidance schedule also results in raising the hydrocortisone levels by a factor of 2-4 (27). In this schedule the animal receives an electric shock every 20 sec. without warning, unless he presses a lever. Each press delays the shock for 20 sec. There is then a fair amount of evidence that adrenocortical activity is a reliable symptom of arousal.

Similar endocrine manifestations were found to be associated with increased population density (28). Crowded mice, for instance, show increased amphetamine toxicity, against which they can be protected by the administration of phenobarbital, chlorpromazine, or reserpine (29). Mason and Brady (30) have recently reported that monkeys caged together had considerably higher plasma hydrocortisone levels than monkeys housed in individual cages. Thiessen (31) found increases in adrenal weights for mice housed in groups of ten and twenty as compared with mice housed alone. The sheer presence of other animals in the same room, but in separate cages, was also found to produce elevated hydrocortisone levels. Table 1, taken from a report by Mason and Brady (30), shows plasma hydrocortisone levels for three animals which lived at one time in cages, affording them the possibility of visual and tactile contact, and at another time in separate rooms.

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Mason and Brady also report that the levels of urinary hydrocortisone by days of the week for five monkeys, from their laboratory, and for one human hospital patient. We reproduce these very suggestive figures

in Table 2 (30).

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The low weekend traffic and activity in the laboratory seem to be associated with a clear decrease in hydrocortisone.

As for the hospital patient, Mason and Brady report that "...he was confined to a thoracic surgery ward that bustled with activity during the weekdays when surgery and admissions occurred. On the weekends the patient retired to the nearby Red Cross building, with its quieter and more pleasant environment." (p. 8).

Summary and Conclusion

If one were to draw one practical suggestion from the review of the social facilitation effects which are summarized in this paper, he would advise the student to study all alone, preferably in an isolated cubicle, and to arrange his exams so that he could take them in the company of many other students, on stage, and in the presence of large audience. The results of such an exam will be beyond his wildest expectations provided, of course, that the student has learned his material quite thoroughly.

I have tried in this paper to pull together the early, almost forgotten work on social facilitation, and to explain the seemingly conflicting results, [illegible] This explanation is, of course, tentative, and it has never been put to an experimental test.

Needless to say, the presence of others may have effects considerably more complex than simply increasing or decreasing the

individual's arousal level. The presence of others may provide cues as to appropriate or inappropriate responses as in the case of imitation or vicarious learning. Or it may supply the individual with cues as to the measure of danger or safety in an ambiguous situation. The paradigm which I examined in the present paper refers to the effects of presence of others which are limited to its arousal consequences. The exact specification of the parameters involved in social facilitation still must be specified. This research is now being carried out in our laboratory (32).

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Table 1

Basal Plasma 17-OH-CS Levels in Same Monkeys Housed in Two Different Rooms (from Leiderman and Shapiro, 30, p. 7)

Subject and time		Cages in separate rooms (μg%)	Cages in same room (μg%)
M-1	9 A.M.	23	34
	3 P.M.	16	27
M-2	9 A.M.	28	34
	3 P.M.	19	23
M-3	9 A.M.	32	38
	3 P.M.	23	31
Mean	9 A.M.	28	35
	3 P.M.	19	27

Table 2

Variations in Urinary Hydrocortisone Level During the week for five Laboratory Monkeys and one Human Hospital Patient (from Leiderman and Shapiro, 30, p.8)

Subjects	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues
	(mg/24 hrs)								
Monkeys	1.88	1.71	1.60	1.52	1.70	1.16	1.17	1.88	---
Patient	---	5.9	6.5	4.5	5.7	3.3	3.9	6.0	5.2

FIG. 1. Feeding of isolated and paired rats (from Harlow, 1932).

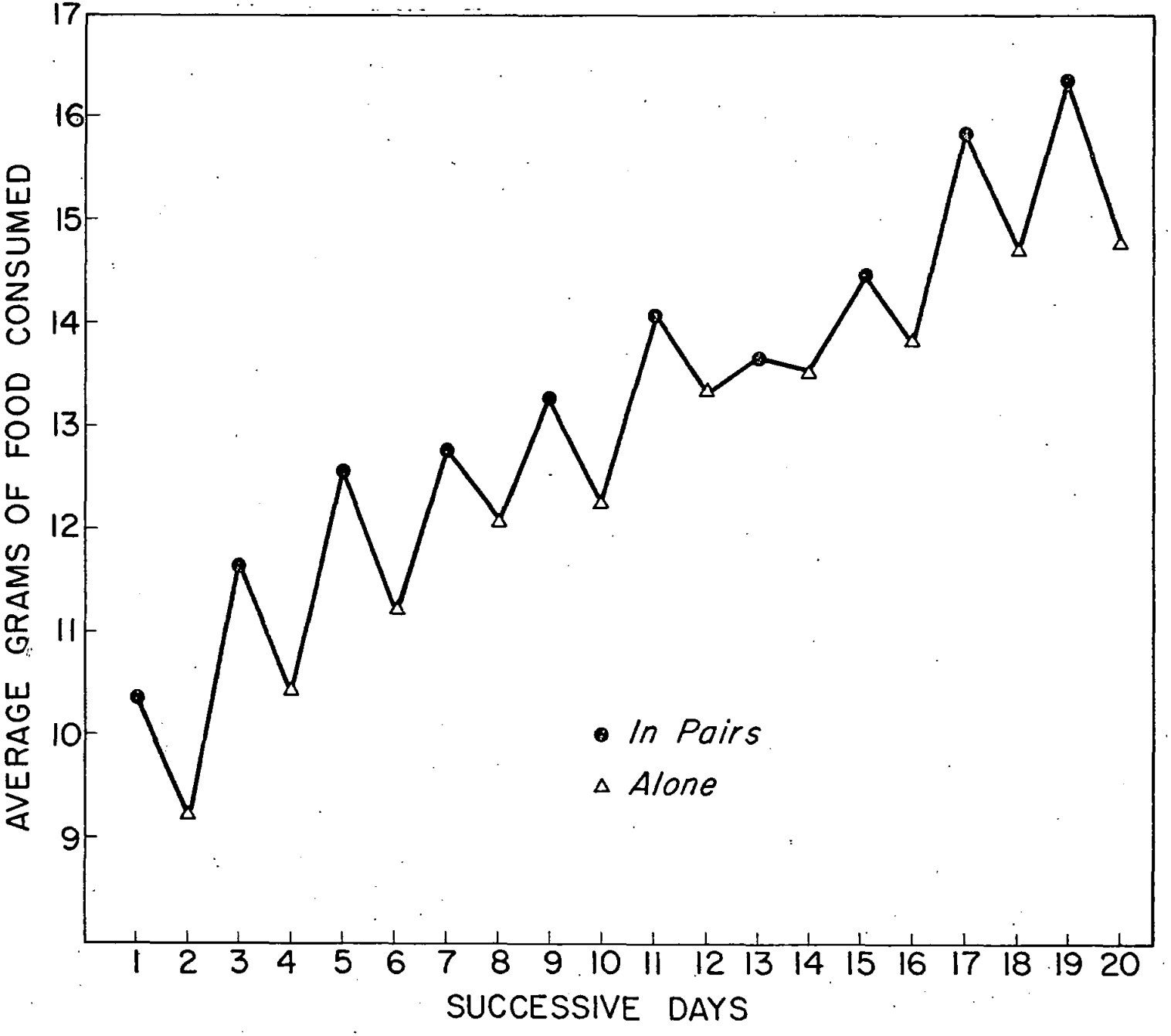


FIG. 2. Nest building behavior of isolated and paired ants (from Chen, 1937).

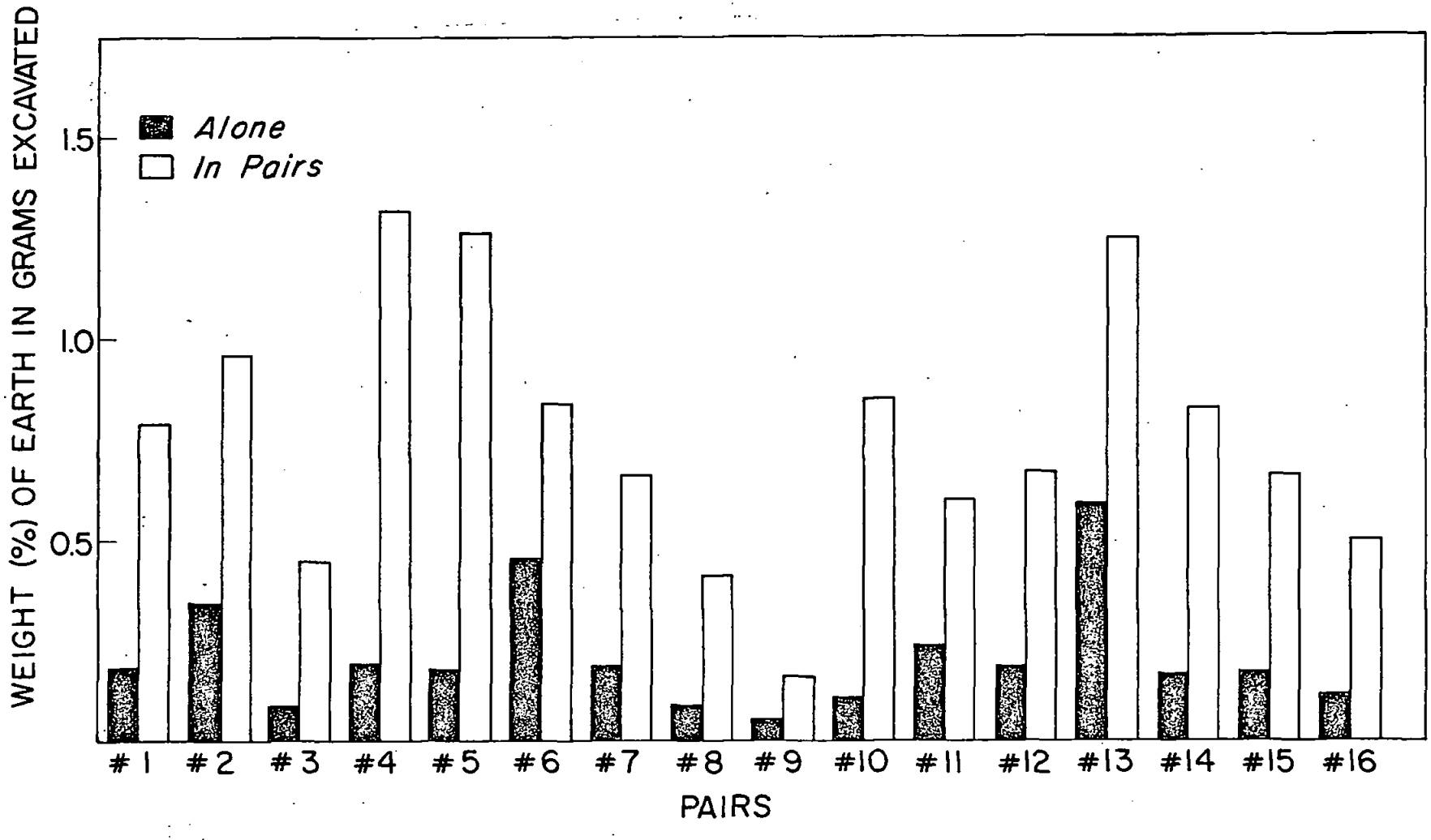


FIG. 3. Maze learning in isolated and grouped cockroaches (from Gates & Allee, 1933)

