## EFFECTS OF LONG-TERM COMPARITION UPON ADULT BEHAVIOUR

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T.N. LING

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#### ABSTRACT

Recent findings have shown that group-reared rats were more dominant in adulthood than those raised individually. This difference was predicted as being due to the fact that group-reared rats did better in competition because of their early competitive experience whereas the solitary-reared animals lacked such early competitive training. In the present experiment. thirty-two male rats were divided into two groups, one (experimental) exposed to competitive and the other (control) to noncompetitive conditions. In the competitive condition rats had to compete for water daily for 70 days. The purpose of the present investigation was to determine whether competition in early life does result in rats acquiring greater skill and practice in competing ie. whether experimental ('competing') rats are more dominant in adulthood than the control ('noncompeting') individuals. Dominance was measured by pairing each 'competing' S once with every 'noncompeting' S in a series of two-minute competitive drinking situations. The findings showed that neither the 'competing' Ss developed greater skill and practice in competing nor did they show dominant behaviour towards the 'noncompeting' Ss. Other findings have also made predictions regarding these two groups 'Competing' Ss were expected to be less 'emotional', more of animals: They should be less sociable active and exhibit more locomotor behaviour. Four more measures were then used to and have heavier adrenal weights. Two activity measures showed 'competing' Ss test the above hypotheses. neither less 'emotional' nor more active or exhibiting more locomotor behaviour than the 'noncompeting' Ss. One of the two sociability measures revealed that 'competing' animals were more sociable than the 'noncompeting' The adrenal weights of the 'competing' animals were not significanimals. antly heavier than the 'noncompeting' animals. All these findings suggest that competition elicited only a mild or short-term effects on the behaviour of animals.

#### CHAPTER 1

#### INTRODUCTION

Variations in the early social experience of young animals may have immediate effects on the young, later effects upon mature animals, or both. Although this is not a surprising fact, it is the aim of many investigators to ascertain the specific kind of early experience that effects a particular adult pattern of behaviour. For example, Fredericson (1951) found that mice taught to compete for food before 35 days of age fought over food when 72 days old, whereas controls without the early competitive training did not fight. King & Gurney (1954) in an experiment where groups of male mice were raised in different social conditions and tested for aggression, found inferior fighting in mice raised in isolation and suggest that there is a latent learning of aggression through the competitive association of mice raised in groups. Seitz (1954) raised groups of rats in which the litters was adjusted to 6 and 12 pups. He found that the rats raised in large litters during infancy tended to be more successful in competition than the rats reared in small litters. Seitz suggests that success in competition for food may have resulted from the fact that rats raised in large litters were exposed to more competition for food early in their lives, and from this experience developed greater skill and practice in competing. Rosen (1961) found that rats living in groups of two Ss each were not more dominant as adults than a control group of solitary-living animals. However, Rosen (1964), in a later study, altered some experimental conditions from his first experiment such as increasing the number of rats living together in each group, prolonging the duration of the group-living experience, and, decreasing the time interval between the end of the early social experience and the start of the dominance tests. He reported that, when isolated and nonisolated male rats competed for food, the former were less dominant than the latter. He concludes that the difference between the two groups presumably due to the fact that animals reared in groups occasionally compete for food, water and living space, and that early competitive training would facilitate their fighting behaviour in adulthood when placed in competition with solitary-reared animals who. supposedly, would lack this early competitive experience. Since Rosen (1964) altered three experimental conditions in his second experiment,

group-reared rats were found to be more dominant than the solitaryreared rats might be due to any of the three experimental conditions rather than early competitive experience. The present experiment was designed, therefore, to study whether early competitive experience does result in rats acquiring greater skill and practice in competing for water in adulthood. Thirty-two male rats were divided into two groups, one (experimental) exposed to competitive and the other (control) to noncompetitive conditions. In the competitive condition rats had to compete for water daily for 70 days, these rats ('competing') should exhibit greater dominant behaviour than the control ('noncompeting') individuals.

Other findings in the literature have also made other predictions regarding the 'competing' and 'noncompeting' animals:

## A. Activity and Locomotor Behaviour

The effects of density on activity and locomotor behaviour within a cage population have received quite extensive examination in recent Stern et al., (1960) for example, housed male rats, aged 23 years. days, either in groups of 15, or singly, for five to six weeks, and at the end of this time found that the group-housed animals exhibited more locomotor behaviour in an open field. Similar results were obtained by Thiessen et al. (1962). Thiessen (1963) found that three-month-old male mice housed in groups of 10 or singly for five days exhibited different levels of activity in a modified open field, the grouped animals being more active; he also found that mice housed in groups of 10 or 20 for four weeks showed an increase in cage activity and were more active in open field compared with isolated controls. Stern and his group and Thiessen and his associates tend to favor the explanation that this increase in activity denotes reduced emotionality. Myers and Fox (1963) studied the effects of 240 days' differential housing conditions (groups of eight or isolation from the age of three weeks) on maze learning in rats. At the end of the period, the rats were trained in a five choice-point multiple U maze until a criterion of 10 consecutive errorless trials, all under 10 sec, was reached. This was achieved in a shorter time by the group-housed rats - not because they made significantly fewer errors but rather because of their shorter running times. During the initial trials, group-reared rats made more entrances into blind alleys but took less time than isolation-reared

animals; when the latter were placed in the maze, frequent 'fear-like'

responses were exhibited. The authors conclude that the experience of total isolation appears sufficient to reduce the isolation-reared rats' locomotor behaviour. In the present experiment, the competitive condition could presumably be viewed as consisting of larger population as compared with noncompetitive (control) condition. In the experiments cited above, group-reared animals were less 'emotional', more active and exhibiting more locomotor behaviour (Stern et al. 1960, Thiessen et al. 1962, Thiessen 1963, Myers & Fox 1963), the 'competing' Ss, in the present experiment, should exhibit similar behaviour.

## B. Sociability

The relationship between competitive experience and sociability has received hardly any experimental attention, even in the ubiquitous laboratory rat. However, there are a few experiments, concerning the relationship between social isolation and sociability, and these show conflicting results. Locke (1936) and Bayroff (1936) found no difference in gregariousness between socially isolated and group-housed rats, but they also found little sign that any of their animals were Angermeier (1959) and Ashida (1964) found attracted to each other. that rats housed in isolation were somewhat less sociable than groupreared animals. From these two studies and others with different species (Kuo, 1960; Schneirla & Rosenblatt, 1961, with cats; Scott 1945, with sheep; and Harlow, 1962, Mason 1960, Sackett et al. 1965, with monkeys, Cairns (1966) predicts that the greater the period of social isolation experienced by an animal, the less it will later approach other animals. Shelly and Hoyenga (1966, 1967), however, found a tendency for isolated animals to be somewhat more gregarious than group-housed animals, as did Latane, Cappell and Joy (1970). Latane et al. (1970) suggest that the differences in gregariousness of isolated vs. group-housed animals might be the development of social repulsion through crowding. If animals are forced to compete with each other for food, water and space in their home cage, they may develop antagonisms and lowered social attraction. Presumably, increased crowding would lead to increased competition and thus decreased attraction. The 'competing' Ss, in the present experiment, which were subjected to chronic competition for water over 70 days should develop antagonisms and lower social attraction (Latane et al. 1970). An attempt will be made to test this hypothesis that 'competing' Ss are less sociable than the 'noncompeting' Ss.

## C. Physiological changes consequent of competition

The effects of population size on the adrenal glands have received extensive examination by Christian (1955). She placed weaning male rats in groups of 1, 4, 6, 8, 16 and 32 for one week. At the end of this period adrenal weights were found to be linearly related to increases in density, with the exception of the population of 32 which showed a decrease in weight from the next lower population. Christian (1955) concludes that the adrenal glands probably increased in weight in response to increased population (or social) pressures and the declined in weight as population further increased could be explained as due to 'social structure deterioration' representing some decrease of stress at the greatest density. However, Christian (1959) had, in later study, found that this reduction in adrenal weight was due to the loss of lipid material from the cortical cells of the adrenal, indicating intense activation. Davis and Christian (1957) found that adrenal activation was correlated with the animal's position in the hierarchy. Mice from 14 populations of six each were ranked from the most dominant to the most subordinate. Adrenal weight was least in the dominant and greatest in the most subordinate animals, while animals with intermediate ranks had adrenal weights intermediate to those abeve and below them in the hierarchy. Thiessen (1964) concludes that social competition in some form, nevertheless, does play a significant part, as evidenced by the studies relating rank-order to organ response, and may correspond to the degree to which physiological changes are observable. In the present experiment, the competitive and noncompetitive cage situations may be looked on as a chronic stress situation, and since 16 'competing' Ss were subjected to additional stress of having to compete for water, we would expect 'competing' Ss have heavier adrenal glands than the 'noncompeting' S..

were subjected to additional stress of having to compete for water, we would expect 'competing' Ss have heavier adrenal glands than the 'noncompeting' Ss.

## Problems

In the present experiment, an attempt has been made to test the following hypotheses:

1. The 'competing' animals are less 'emotional', more active and exhibit more locomotor behaviour.

The 'competing' animals are less sociable than the 'noncompeting' animals.
 The 'competing' animals will be more successful in competition for water than the 'noncompeting' animals.

4. Advenal weights for the 'competing' arimals are heavier than the 'noncompeting' animals.

#### Early Social Experience

The subjects were 32 naive male hooded rats (Otago strain N.Z.B.W.S.) weaned at 23 days of age. At weaning, male rats from each litter were randomly assigned to either the experimental or the control The \*16 experimental rats ('competing' = C ) were housed in 60 x group. 60 x 24 cm wooden cage with a removable wire-mesh lid and was equipped The 16 control rats ('noncompeting' = NC) lived with one water bottle. in identical cage which was equipped with 16 water bottles. Both the 'competing' and the 'noncompeting' Ss were be given a single daily 50-min drinking period ie. they were under approximately 23-hour water deprivation Since only one water bottle was available to the 'competing' schedule. group, they had to compete for water during the 50-min period (It was found that 50 minutes were sufficiently long enough for all 16 rats to obtain and satisfy their thirst). Weight for both C and NC were recorded weekly to ensure that none of the rats would suffer from water deprivation (Fig. 1). Food was always available ad lib. Rats were maintained under these conditions for 70 days prior to their first test in the square open field.

#### METHOD

Two measures were used for measuring activity and locomotor behaviour of the 'competing' and 'noncompeting' Ss:

#### Square open field and Activity platform measures

#### Subjects

The rats were 94 days of age and both the C and NC Ss were randomly divided into two equal groups, 8 for each measure. They were given 24-hour drinking before their first testing and were colour coded

\* the size of 16 rats used for each group mainly for laboratory convenience

at 87 days of age for later indentification.

## Apparatus

The testing apparatus consisted of:

- A wooden open field measuring 60 x 60 x 24 cm high. The floor of the apparetus was marked out into 15 x 15 cm squares and was illuminated by a 40 W fluorescent lamp suspended 75 cm above it.
- 2. A similarly illuminated Lefayette A501 Activity Platform.

#### Procedure

Each rat was placed in a corner of the square open field and every 5-sec interval over 9 10-min period, the observer noted whether it was in a corner (C), wall (W) or inner (I) 15 x 15 cm square and if it was ambulating (a), grooming (g), rearing up on its hind legs (r) or remaining immobile (i). In addition, total number of squares entered (N) and fecal boli (F) over the 10-thin period were also recorded. The other, as yet untested, 8 Ss from each group ('competing' or 'noncompeting') were tested individually on a similarly illuminated Lafayette A501 Activity Platform for 10 min each. In both measures 'competing' and 'noncompeting' Ss were tested alternately and at the end of each trial, the field was swabbed with a damp cloth. All testing occurred between 9 a.m. and 5 p.m. and approximately 40 db of white noise provided on auditory masking background during this time.

Two methods were used for measuring social behaviour of the 'competing' and 'noncompeting ' Ss:

## 1. Latane's method

#### Subjects

16 rats (95-day-old) from each group (C & NC) were randomly divided into 8 pairs that served together throughout the five days of the experiment. The rats were given 24-hour water schedule before the start of each day testing.

#### Apparatus

The apparatus was a circular open field, 1.2m in diameter with an 0.43m wall. It was painted brown, and brightly lit (four 40 w fluorescent lamps suspended 75 cm above it). The wooden floor was marked off with white lines into 49 sections of equal area and approximately equivalent shape by a series of concentric circles and radii. Each of these areas was labeled with a number from 1 to 49 for ease of recording the position of the rats.

#### Procedure

Each pair of rats was placed once daily in the open field for a five-min period and their locations recorded at 5-sec intervals. The mean distance between the two rats over the 60 5-sec periods was calculated from the recorded locations and could range from 0 to 100 cm, the lower scores indicating higher gregariousness. In addition. the observer recorded the time two rats were in physical contact (contact was timed whenever one rat had bodily contact with the other rat), and the number of times a pair of rats was found in the same square over the 60 5-sec periods were also calculated. The 'competing' and 'noncompeting' pairs were tested alternately and at the end of the 5-min, rats were removed and the field cleaned with a damp sponge. Daily testing occurred between 9 a.m. and 1 p.m. and 40 db white noise was used as an auditory masking background.

## 2. Syme & Syme's Photographic Method

#### Subjects

C and NC Ss (99-day-old) were randomly divided into two equal groups ie. C1 & C2, NC1 & NC2; only C1, NC1 and NC2 of 8 Ss each were used in this measure.

### Apparatus

A time-sample photographic method (Syme & Syme, 1972) was adopted in order to obtain a record of the movements of a group of 8 animals within a large Latane's circular open field. Illumination was provided by six 40 W fluorescent lamps placed around the perimeter, but 75 cm above the field.

## Procedure

The same procedure was used for the three groups-NC1, C1 and NC2, and they were tested in that order. Rats from each group were placed into a corner of the field and after 30 sec had passed, photographs were taken every 30 sec for a 10-min period. In this way, 20 photographs of the whole field were obtained. These photographs enabled the exact positioning of each rat every 30 sec over the test period. The natural black markings of the hooded rats proved to be distinctive enough for the individual recognition of each rat in the 20 photographs. Immediately after the last trial of the Dominance Measure, photographs were again taken for both NC1 and NC2 Ss (109-day-old). NC1 Ss were used in the Dominance Measure; the aim of this was to see whether five days competition made any different The field was cleaned after every trial. to the behaviour of the animals. Testing occurred between 2 p.m. to 3 p.m. and 40 db white noise was used.

The average distance of each animal in a group from every other animal was calculated from the photographs, and in addition the number of occasions two animals were found occupying the same square were recorded. Finally, also from the photographs, the experimenter recorded the number of times two animals were in physical contact while occupying the same square (contact was scored whenever one rat had bodily contact with the other rat)

## Dominance Measure

### Subjects

NC1 and C1 Ss (100-day-old), each consisted of 8 Ss were used.

#### Apparatus

The apparatus used for testing dominance is functionally similar to the one used by Syme and Pollard (1972). It consisted of a wooden box measuring  $0.33 \ge 0.33 \ge 0.33$  m with illumination provided by a 10 W bulb through a plexiglass roof. A plexiglass door formed one side of the box and allowed direct observation. The remainder of the apparatus was painted in white semi-gloss. In one wall was a recess at floor level and a hole in the floor of the recess allowed an animal to drink from a water trough outside the chamber. The dimensions of the recess (diameter 3.0 cm and dept 2.0 cm) were used that only one animal could fit its head in to drink at any one time.

## Procedure

The experiment was divided into two distinct phases: a. Habituation

A 23-hour water deprivation schedule was imposed and each S was habituated to the apparatus individually for 2 min per day for 5 days. The amount of water drunk by each rat was measured by weight gain over the 5-min test period. After five days of habituation, all Ss were able to approach the water trough and drink within 10 sec of being placed in the apparatus. NC1 and C1 Ss were habituated alternately. b. Dominance test

Starting at 105 days of age, each NC1 S was paired with C1 S in a competitive drinking situation for two minutes per day for 5 days. The following procedure was used for the dominance tests. Each pair of rats was placed in the middle of the box and released. The length of time in sec that each S spent drinking from the water trough during the 2-min period was recorded, and the amount drunk was measured by weight gain during the 2-min test period.

Ss were provided with their regular 50-min drinking period upon completion of all daily trials during both habituation and dominance test periods. The weight of advenal glands was used as the index for measuring any physiological changes consequent of competition:

### Adrenal Clands Measure

Subjects

The NC1 and C1 Ss were again used and they were 116 days of age.

## Apparatus & Procedure

A pair of adrenal glands for each rat was removed cleaned of the surrounding tissues and the glands were weighed in pairs to the nearest grams. The paired adrenal gland weights were expressed in per body weight of the animal times 100 gm.

#### CHAPTER 3

#### Results

#### Square open field and Activity platform Measures

Defaecation soldom occurred during the testing sessions, so this index was not analysed. A series of Mann-Whitney U tests were applied to the data. The results summaried in table 1 in the Appendix show no significant different between the 'competing' and the 'noncompeting' Ss.

#### Sociability measures

## 1. Latane's method

#### Effect of long-term competition

The average distance between rats for the 'competing' group was 33.9 cm, and that for the 'noncompeting' group was 33.6 cm. An analysis of variance comfirmed that Ss in the 'noncompeting' group were no more sociable than the 'competing' Ss ( F = 0.05, df = 1/14, p 0.05). The average time spent in direct physical contact for both groups was found to be insufficient to provide a measure of sociability. Using Mann-Whitney U test, the average proportion of 'noncompoting' Ss occupying the same square was also not significantly greater (U = 30, p 0.05) than the 'competing' Ss (Fig. 2).

#### Effect of day of testing on gregariousness

The average distance rats kept between themselves shortened considerably ( F = 4.18) df = 4/56, p 0.01). On the first day of the experiment, the average distance between rats was 47.00 cm. By the last day, the average distance was 38.40 cm (Fig. 3)

Mann-Whitney U test was used because of too many 'O' in the raw scores

## 2. Syme & Syme's Photographic method

Effect of long-term competition

The average distance between NC1 Ss was 405.2 cm and between NC2 Ss was 376.9 cm; this could presumably be due to sampling error. The average distance between C1 Ss was 380.9 cm, and using analysis of variance, the overall main effect was significant ( $\mathbf{F} = 5.68$ , df = 2/21, p 0.05) ie. the average distance between C1 Ss was significantly shorter than that between NC1 Ss, however, it was not significantly shorter than that between NC2 Ss.

The mean proportion of C1 Ss occupying the same square was significantly greater than the occupancy by NC1 Ss ( U = 2, p 0.01). In this case, however, the mean proportion of C1 Ss occupying the same square was also significantly greater than the occupancy by NC2 Ss ( U = 4, p 0.01). This indicated that animals housed in competitive environment were more sociable than enimals housed in noncompetitive situation on the 'same square' measure, The pattern was similar when the measure such as rate in bodily contact while occupying the same square was considered, the average proportion of C1 Ss occupying the same square was again significantly greater than that occupied by NC1 Ss (U = 7, p 0.01), and also significantly greater than NC2 Ss (U = 8, p C.01). This measure also showed that 'competing' Ss were wore sociable than 'noncompeting' Ss.

Effect of short-term competition

The experiment was arranged as follow:

Refore	en els van den en a sussen de de sector d	After
NC1	a period of five days competition in Domin- ance Measure.	NCI
NC2	no competition, remain in their home cage	NC2

The average distance between rats for the NC1 rats before the 'competitive period' was 405.2 cm, and after five days competition the average distance was 572.6 cm. With NC2 Ss the average distance between rats was 576.9 cm 'before' and 'after' it was 438.5 cm. Using analysis of variance with repeated measures on one factor, the main effect was significant ( F= 17.13, df = 1/14, p 0.01), this as mentioned earlier could be due to sampling error. However, this sampling error was in the opposite direction to the data ie. there was significant interaction (Fig. 4) between NC1 and NC2 animals ( F = 43.39, df = 1/14, p 0.01). This indicated that with 'noncompeting' animals, five days of competition for water resulted in greater gregariousness.

The average proportion of rats occupying the same square 'before' and 'after' the experiment remained roughly similar for both the NC1 and NC2 rats (Table 2). However, when the measure such as rats in bodily contact while occupying the same square was considered (Table 5), there was a significant difference between the 'before' and 'after' experiment for NC1 rats (U = 5, p 0.01), but not significantly different between the 'before' and 'after' experiment for NC2 rats (U = 14, p 0.05). These results illustrate the significance of immediate past experience rather than the longer term effects of the pre-living condition is. a five day competition is sufficient to mate animals more sociable. However, it must be noted that in this case NC1 Ss were bandled by the experimentor for five days while NC2 rats were not bundled. Hendling consisted of picking the animal from the home cage and putting it into a small metal cage and then transporting it to the testing room and vice versa. The effect of hendling might also contribute to greater gregariousness for NC1 rats.

## Dominance Measure

Expected values for the amount drunk measure were calculated from the baseline ( ). This was done by summing the amounts drunk for each of the 16 Ss over the individual measures and then calculating the proportion of the amount drunk by the 'competing' S of each competitive pair. In this way, it was possible to establish an expected proportion of weight gain for each of the 'competing' S in competition which was based on the individual performance of that subject. As a result ve could calculate using Wilcoxon Matched-Pairs Signed-ranks Test as to whether those Ss who had been subjected to the chronic competition performed any better in competition than would have been expected on their individual We found T = 11, p 0.01; 'competing' Ss didn't do any better behaviour. than would be expected by chance. Unfortunately, I didn't record the time each S drank during habituation (which, of course, was a mistake), however, since all 'competing' Ss drank over 50% level ( T = 0, p 0.01), I took 50% level as the criterion and compared this with the expected proportion time taken for each of the 'competing' S. The results showed that 'competing' mimals didn't do any better than the 'noncompeting' animals (T = 6, p 0.01).

Finally, the median value for amount drunk by the 'competing' Ss during habituation period was 13.25 and that during competitive period median was 11.25. Similarly with 'noncompeting' Ss, median values were 11.3 and 8.05 respectively. Using Wilcoxon Matched-Pairs Signed Ranks Test the amount drunk during habituation by 'competing' Ss was significantly greater than during competitive period (T = 1, p C.02), and also with 'noncompeting' Ss (T = 2, p 0.02).

#### Adrenal Gland Measure

Average adrenal gland weights for the 'competing' Ss were 14.4 gm and for the 'noncompeting' Ss were 12.9 gm. Using simple t-test, the paired adrenal gland weights did not differ significantly between the 'competing' group and the 'noncompeting' group (T = 1.98, p 0.05)

#### CHAPTER 4

#### DISCUSSION

# The 'competing' animals are less 'emotional', more active and exhibiting more locomotor behaviour:

The results do not support the hypothesis that 'competing' Ss are less 'emotional', more active and exhibit more locomotor behaviour, and are inconsistent with the above studies by (Stern et al. 1960, Thiessen et al. 1962, Thiessen 1963, and Hyers & Fox 1963). All these studies indicate that group housing as opposed to isolation leads to an increase in activity. However, the reverse was found to be the case by Essman (1966) and Weltman et al. (1966) i.e. isolates generally had higher levels of activity than the grouped mice. Essman (1966) suggests a few factors that might contribute to the discrepancies in the literature on this subject: 1. In the various studies differential housing has been introduced at different ages between weaning and adulthood, and different methods have been used to measure activity

2. Other factors are the length of time spent in the different housing conditions, sex and strain of the animals, the size and type of cages, and the social organisation within the group.

Therefore, there is no conclusive evidence regarding the hypothesis that group-housed animals exhibited higher levels of activity than the isolation-reared animals, and the present study only adds further doubts to the hypothesis. It is, therefore, essential for further research in this area.

## The 'competing' animals are less sociable than the 'noncompeting' maimals

The results do not support the hypothesis that the 'competing' animals are less sociable than the 'noncompeting' animals: instead the 'competing' animals are more sociable. This, of course, is in direct contradiction to the prediction made by Latane, Cappell & Joy (1970). Why are isolated animals more gregarious? Two explanations are possible: 1. A number of investigators (Latane, 1969; Latane & Glass, 1968; Morrison & Hill, 1967) have shown that rats seem less afraid when together than alone. It is possible that the chance to reduce fear is a major motive underlying social attraction, and that the increased gregariousness of isolated rats reflects their increased fear.

2. The fact that isolated animals are more sociable may be due to the effect of general stimulus deprivation or lack of environmental change relative to grouped animals. A number of studies (Glanzer, 1953; Premack, Collier, & Roberts, 1957; Robinson, 1957) have shown that rats which are kept in a relatively unchanging environment or deprived of stimulation show more locomotor behaviour than stimulated animals. Thus, isolated rats may have been more responsive to and 'interested' in each other than group rats. These two possibilities, however, are inconsistent with Latane, Cappell & Joy (1970) results, and the present experiment raises further doubts regarding isolated and aggregated animals studies.

The discrepancies in the literature on the social behaviour of isolated and grouped rats, could possibility be due to the different methods used to measure sociability. Previous investigation of social attraction in rats have often used settings involved S's reaction to a caged animal (Locke, 1936; Bayroff, 1936; Tolman, 1961; Shelley & Hoyenga, 1966,1967, Salazar, 1968). The main problems encountered with these measures, however, were the unknown effect of caging the stimulus animals (Guhl, 1942) and the relatively small percentage of time spent by S in the vicinity of the stimulus rat (Walton & Latane, 1972). An alternative method introduced by Latane (1969), however, presents a number of problems too (Syme & Syme, 1972). Firstly experimenter is physically limited to observing a small. number of animals simultaneously in the field. In order to study the social behaviour of grouped animals this requires the removal of Ss from the majority of their cagemates. For example Latane, Cappell, & Joy (1970), comparing the sociability of isolates and rats housed in varying degrees of social density, found a difference between isolated and grouped animals but none between the particular group conditions. However, although Ss in each test pair were identically housed, individual rats were placed with unfamiliar animals in the test situation. Since both rats were strangers it is possible that any group-specific effect was obscured.

An experiment designed to test the specificity of attraction of rats for cagemates (Latane, Schneider, Waring, & Zweigenheft, 1971) illustrates another aspect of this problem. Although all Ss were housed in pairs, trios were placed in a circular open field so that, in the test situation, two rats were cagemates and the third a stranger. It was argued that if an attraction did occur ketween familiars the average distance between these Ss should have been less than that between unfamiliar animals. Using this method, however, the role of the free-moving unfamiliar animal could not be controlled. To this animal both other Ss were unfamiliar and no choice was available. Assuming that identical cage conditions lead to equal sociability no difference in distances would have been expected. At least four animals were required to present a choice to all Ss.

A further criticism of Latane 's technique concerns the used of a round open field. Presumably this was used to avoid position preferences, but the method presents problems similar to those encountered in the social-preference study. Just as the third S in the trio had no choice between animals, one of a pair of rats within the round open field has only one 'land-mark' that of another rat. Had a choice between another animal and a corner been provided it is possible that S may have prefermed the environmental landmark. This criticism is supported by the fact that most laboratory rats are housed in rectangular cages. If corner preference outweighs any observable social effect the latter cannot be regarded as the more important constituent of the enimal's behavioral repertoire.

Syme & Syme (1972) adopted a time-sample photographic technique for study in animal sociability, and found the 'same-square' measure is a better measure of animal sociability, as did the present experiment. They critised Latane's distance measure as unsatisfactory measure of sociability in that it is not known how close a rat must be to another before it is relevant stimulus in a dynamic group situation.

Due to various methodological deficiencies, it is not yet clear as whether isolated rats are more sociable or less sociable than the grouped rate. The present experiment is quite consistent with Angenmeier (1959) and Ashida (1964) studies that group-reared animals were more sociable than solitary-reared animals. Cairns (1966) suggests that animals reared in isolation would be less likely to develop response patterns that require the presence of a conspecific object (rat) than would animals which have been maintained with their own species (the emphasis is not upon what the animal has been 'deprived' of, but what he has been exposed to). The isolated animals, therefore, tended to move towards an empty space rather than to their own species. A 'competing' S. in the present experiment. had had physical contact with other rats daily during competition for water; through such association daily with other rats, he should get familiar

with elimination odors and conspecific events from other rats. 'Therefore, when this rat was placed in a circular open field, he should have a greater tendency to move towards other rats.

Another explanation for differences in gregariousness of 'competing' vs. 'noncompeting' animals might be the development of the phenomenon of the behavioral sink (Calhoun, 1962). During competition for water 'competing' rats had to push in order to get to the water nozzle. In consequence, satisfaction of thirst required a continuous effort lasting several minutes. This deily gathering round the water nozzle is a sufficient condition for the development of social attachment. Sociability behaviour may be social only because the situation makes it so (Shelley & Noyenga, (1966).

These two explanations are inconsistent with the fact that when two animals were put in the circular open field, 'competing' animals didn't exhibit greater gregariousness than 'noncompeting' animals. This condition warrants further investigation.

# The 'competing' animals will be more successful in competition for water than the 'noncompeting' animals

The data, indicated that the 'competing' animals neither developed greater skill and practice in competing for water in adulthood nor did they show dominant behaviour towards the 'noncompeting' animals. Τt should be emphasized that the 'competing' Ss seemed to drink a bit more during habituation (Fig. 5), but the amount drunk for these Ss were not significantly greater than the 'noncompeting' Ss ( F = 3.46, df = 1/14, p  $0.01)_{-}$ On the first day of the competitive period, a 'competing' S drank slightly more than his previous day; this could be due to social facilitation ie, the presence of another animal facilitating his drinking habit. The 'competing' animals were also used to pushing while competing for water, but the 'noncompeting' animals soon learned the tactics, as shown in the second day of competition, and were doing just as well as the 'competing' animals. The two curves tend to level off after further competition (Fig. 5).

The data are in favor with those studies by Ginsburg and Allee (1942), Yen et al. (1958), Janssen et al. (1960), Kuo (1960), Uyeno and Benson (1965), and Uyeno and White (1967), who all showed that socially isolated animals were more dominant than nonisolated ones. However, the results appear to disagree with those of King & Gurney (1954), Seitz (1954), and Rosen (1964) who all found relatively slow, inactive, and 'submissive' responses in isolated animals. Uyeno and White (1967) suggest that these responses were probably due to typical naive unadaptive behaviour such as timidity or freezing behaviour, attributable to a novel test environment. The apparent discrepandes between the results among the studies could be due to species differences and different methods of testing dominant behaviour.

# Adrenal gland weights for the 'competing' animals are beavier than the 'noncompeting' animals

The results do not support the hypothesis that adrenal gland weights for the 'competing' animals are heavier than the 'noncompeting' animals. This, of course, is in direct contradiction to Thiessen's (1964) conclusion that social competition, however manifested, is a prominent feature of many density effects. Then what are the conditions that lead to adrenal enlargement evident in dense population? Barnett (1958) describes the changes which the adrenals of rats undergo as a result of conflict. His control males, kept each with a female in small cages, and male kept in small all-male colonies, had a mean adrenal weight of 62 ± 2.6 mg. Males from the strife-ridden colonies in which females were present had adrenal about thirty per cent heavier ( $83 \pm 5.3$  mg). Barnett (1958) concludes that adrenal enlargement is non-specific consequence of hostile social interit occurs not only in the victims of assault but also in the action: aggressors; the raised hair, defaecation and urination of the latter, as they move in to attack, are no doubt indications of the autonomic activity which perhaps helps to bring about the adrenal changes. In mice living in groups of 4, 8, or 16 to a cage, Southwick and Bland (1959) found no significant

differences among the groups in adrenal weight unless wounded animals were compared with nonwounded. This comparison revealed that only the wounded animals had significantly heavier adrenals. These investigators concluded that wounding is the essential operant condition in advenal changes within populations and that density acts indirectly by creating a situation in which fighting and wounding are more likely to occur. However, it must be emphasized that social stress and its concomitants cannot be studied in the amenable laboratory rat (Barnett, 1964). Scott and Fredericson (1951) have shown that they can, even when attacked only by other tame rats. The 'competing' Ss, in the present experiment, displayed only a diluted form of agonistic behaviour: in particular there were hardly any authentic form of combat displayed by the 'competing' Ss. In competition for water. the only forms of behaviour observed were the pushing and occasionally 'playful' The results do show the possibility attack among the 'competing' animals. that early experience in competition is not crucialie. competition has only a short-term effect on the behaviour of animals. Therefore, it could presumably bo the severity of stress that animals are exposed to, which leads to enlargement of adrenal glands.

It is unfortunate that most work on adrenal function in relation to social stress has inevitably been based on changes in adrenal weight: a better criterion of function is needed. Another questionable feature is the comparison of changes in laboratory animals with those that occur, or are believed to occur, in wild-type manmals.

## Conclusion

This study reviews contradicting results regarding the relationships between early competitive experience and later adult pattern of behaviour. Although the results cannot be regarded as conclusive, the use of the various measures described shows that such relationships cannot be assumed to be as simple as previous investigators hitherto believed to be.

#### Suggestions

It is quite proper to make some suggestions for future research:

- 1. It would seem clear that the 'competing' animals are more sociable than the 'noncompeting' animals. It will be recalled that solitary-reared animals are more gregarious than grouped animals, then if it is possible to create a situation where isolates need to compete for water, we would expect such animals exhibit more gregariousness in later lives.
- 2. It is not yet clear what the motivational variable involved in sociability behaviour is. Short-term social competition is sufficient to produce the behaviour, but whether early handling of animals is essential or not remains unclear. Therefore, if it is possible to create the same experimental situations as the present study with one group of animals competing and handled whereas with the other group no competition is available but handled, variations in sociability behaviour might be observed between these two groups.
- 3. Finally, if it is possible with Latane's method to test the animals in different group sizes, say in groups of three or four and to observe whether number of animals in the open field effects sociability behaviour.

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## APPENDIX

 $i^{f}$ 

## Table 1

Median activity scores for 'competing' and 'noncompeting' rats in both the open field and the activity platform, results of Mann-Whitney U tests (none is significant)

Measure	noncompeting $(n = 8)$	$\begin{array}{c} competing \\ n = 8 \end{array}$	υ
C	67	74	27
W	42.5	39.5	27
ľ	10,5	10	27
Ð.	51	54	25
Ę	8	4.5	16
ľ	37.5	47	20
ì	17	12.5	22
N	126.5	144.5	14
Activity platform	317.5	443.5	19

## Table 2

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The median values of NC1 and NC2; rats occupying the same square 'before' and 'after' the experiment:

<u>ġĸŗġ</u> ŗĸmţĸĸĸġĸv <b>ĸġĸĸġġĊijġ</b> ţġġġġġĸĸġŀĸ <sup>ĸ</sup> ĸkonfilandġĊĊġŀruġłącujukondenosa novitik- recontero Bito	าสารที่สุดชีวิตชี <mark>วิตชีวิตรีวิตรอน</mark> าสมัยสม <sub>า</sub> รมารณาจากกรรมสารที่สุดชีวิตชีวิตรอนกรรมราชกรรมกรรมกรรมกรรมกรรมกรรมกรรม	Januaron fatelanda ta anti-anti-anti-anti-anti-anti-anti-anti-	de seguence, altraige dan Arabitation
Measure	Subject $(n = 8)$	Before	After
fanalistalaan ay karange ay yada ay karange a	NC1	2	
'Same Square'	NC2	2.5	2.5

## Table 3

The median values of NC1 and NC2 rats in bodily contact while occupying the same square 'before' and 'after' the experiment:

Measure	Subjects ( n = 8)	Before	After
'Bodily contact + Same square'	NC1	1	3
	NC2	1.5	2
Energia a la companya de la companya	anders and the second second second second of the second second second second second second second second secon		in an



Fig. 1. Means body weights for the 'competing' and 'noncompeting' groups from 30 to 86 days of age.



Fig. 2. Mean proportion of rats occupying the same square.



Fig. 3. Average distance between 'competing' and 'noncompeting' rats by days.



Fig. 4. Effect of five days competition on average distance between rats.



Fig. 5. Amount of water drunk during both habituation and competitive situations.