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BRIEF REPORT

Active Transmission of Poison Avoidance among Rats?

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Results of a recent study by Danguir and Nicolaidis suggest that pairs of rats trained to avoid ingesting LiCl solution will physically restrain naive conspecifics and actively interfere with the naive rats' ingestion of a similar-tasting NaCl solution. If confirmed, this result would be the first controlled demonstration of an active role of the transmitter of behavior in a social learning situation. Replication with more precise measure of NaCl ingestion revealed that evidence in the Danguir and Nicolaidis study of socially induced reduced consumption by naive subjects resulted from a measurement error. The observed small intake of NaCl by naive subjects may be interpreted as resulting from neophobis rather than social interaction.

Adult rats trained to avoid ingesting a highly palatable diet, in response to that diet's previous association with poison, can influence their weaning young to direct their feeding exclusively to a less palatable safe diet (Galef, 1978; Galef and Clark, 1971a,b). Analysis of the behavioral interactions underlying this transfer of an acquired feeding preference from adult to young has revealed that the adults play a basically passive role in the transmission process (Galef, 1976). Rather than actively intervening in the behavior of the young rats, the adults constitute part of a stimulus situation in which the responses of the young lead them to acquire the diet preference of the adults. Review of the literature similarly suggests that the role of the transmitter in a wide variety of social learning situations is passive rather than active (Ewer, 1969; Galef, 1976). Although it has been reported anecdotally that experienced primates will actively pull naive conspecifics away from potentially dangerous objects (Menzel, 1966, p. 134; Stephenson, 1967), analogous examples of active transmission of behavior are neither available in the non-primate literature nor are they

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unequivocally established in controlled settings (see Galef, 1976, p. 88).

Danguir and Nicolaidis (1975) recently reported that Wistar rats, trained to avoid ingesting a flavored solution, appeared to actively restrain their naive cage-mates from ingesting a similar tasting solution. If true, this result would stand as a unique counterexample to generalizations concerning the passive role of the transmitter in social learning processes in non-primates.

Because our own experiment is essentially a replication of the Danguir and Nicolaidis (1975) study, it is necessary to describe their method and results at some length. The interested reader is referred to the original paper for a detailed description of their procedures and outcomes.

Danguir and Nicolaidis established 18 groups of female Wistar rats on ad lib food and water. Each group was comprised of three subjects maintained in a group cage from weaning to maturity. In each of 12 of these trios (*experimental trios*) two members were trained at maturity to avoid drinking salty solutions. The trained pairs were, on two occasions, water deprived for 24 hr and then placed together for 15 min in a cage with a bottle containing a toxic 0.9% LiCl solution. The third member of each of these 12 experimental trios, the naive member, was similarly deprived, placed in a separate cage, and allowed access to tap water while the trained members of its trio were receiving exposure to LiCl solution. Members of the remaining six trios (*control trios*) were treated identically to members of experimental trios except that the trained pair of subjects in each control trio were presented with nontoxic 0.9% NaCl solution on the two training days.

Measurement of solution intake on the second of the training days revealed that the trained experimental pairs had learned to avoid LiCl solution (mean intake = 0.1 ml), while members of trained control pairs continued to ingest NaCl solution (mean intake = 10.1 ml).

Twenty-four hours following completion of training each of the 18 trios, 6 control and 12 experimental, was again water deprived for 24 hr, moved as an intact trio to a test cage, and provided with 15 min of access to a bottle containing 0.9% NaCl solution. The trained pairs of experimental subjects generalized the aversion they had learned to LiCl solution to NaCl solution and drank very little of the latter on the test day, while the trained pairs of control subjects drank from the spout for extended periods of time.

Observation of the interactions of trained and naive trio members in control and experimental groups revealed additional differences between groups. In 7 of 12 experimental trios the trained pair of rats was observed to "climb on top of the naive one and push it down." Further, the trained rats were observed to interpose themselves between the naive rat and the spout of the bottle, blocking the latter's access to the NaCl solution. No

such behaviors were observed between the trained and naive subjects in control groups.

On the test day, to determine the effects of the observed differences in social interaction on consumption of NaCl by naive rats in control and experimental trios, Danguir and Nicolaidis first measured the total amount of NaCl solution consumed by all three members of each trio. The amount consumed by each individual was then estimated by multiplying the total intake of a trio by the proportion of total trio drinking time a given individual spent in contact with the spout. In the case of the naive members of experimental trios there was little chance of error. The naive member of each experimental trio did almost all the drinking and all consumption could safely be attributed to it. In control trios all three rats drank "with approximately the same intensity" so it was decided to assign one-third of the total consumption to each rat.

The main result of the Danguir and Nicolaidis study is presented in Fig. 1 which indicates the mean consumption by the seven naive rats in experimental trios exhibiting intragroup aggression and the estimated mean consumption of the six naive members of control trios (one-third of the total amount consumed by control trios). As can be seen in the figure, naive experimental subjects in trios exhibiting aggression drank consider-

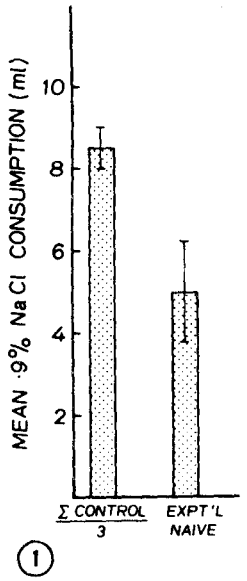

FIG. 1. Prepared from data presented by Danguir and Nicolaidis (1975, Table 1). Mean amount of 0.9% NaCl solution consumed by naive experimental subjects and naive control subjects. The latter amount was calculated by dividing the total amount consumed by the entire control trio by 3. Flags indicate ±1 SE.

ably less than the amount estimated to have been consumed by each individual in control trios.

These data, as presented, strongly suggest that the aggressive behavior of the trained members of experimental trios was sufficient to reduce the consumption of a toxic tasting solution by naive group members during the period of group interaction. The evidence of reduced consumption of a toxic tasting solution actively induced by social interactions, appears compelling.

However, as Danguir and Nicolaidis indicate in their paper, the assumption that all three members of each control trio ingested equal amounts of NaCl solution on the test day is a possible lapse in the rigor of their procedure. If it were the case that the naive subject in each control group ingested less NaCl solution than the trained pair of control subjects, then apparent differences in ingestion of NaCl solution by naive members of control and experimental trios would disappear.

There is, in fact, reason to believe that naive control subjects might drink less NaCl solution on the test day than did trained control subjects. The naive control subjects were encountering a salty solution for the first time on the test day and any hesitancy on their part to ingest a novel solution in the brief 15-min test period could result in their drinking less NaCl than their trained trio-mates already familiar with ingesting salty solutions.

We, therefore, undertook to replicate as closely as possible the Danguir and Nicolaidis (1975) procedure while increasing the accuracy of measurement of consumption by individual members of trios. In addition to determining the total amount of fluid consumed per session and the total time spent drinking by each subject, we also weighed each subject before and after each 15-min drinking session. Care was taken to weigh the few fecal boli deposited during drinking sessions and to add their weight to their source. Urination was not observed in the 24-hr water-deprived subjects during drinking sessions.

Like Danguir and Nicolaidis we observed instances of aggressive interaction in experimental groups. Like them we found that the naive members of experimental trios in which aggression was observed ingested significantly less NaCl solution on the test day than the estimated intake of naive members of control trios (one-third the total amount ingested by control trios). However, as can be seen in Fig. 2, which shows the mean amount of fluid ingested by individuals in control groups (determined by adding the total weight gains of the three control subjects over the 15-min test period and dividing by 3) and the actual mean weight gain of naive control subjects, we found that the assumption that all three members of control groups ingested the same amount of NaCl solution on the test day was not accurate (Mann–Whitney U test, $U = 1.0$, $P < 0.02$). The two different methods of calculating NaCl ingestion by naive control subjects

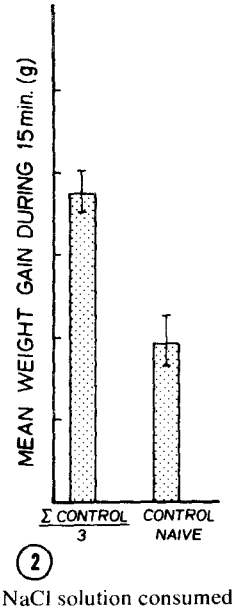

FIG. 2. Mean amount of 0.9% NaCl solution consumed by naive control subjects calculated by dividing the total weight gain of control trios by 3 and by directly measuring the weight gain of naive control subjects. Flags indicate ±1 SE.

produce the same apparent difference in intakes as Danguir and Nicolaidis found between naive experimental and naive control subjects. The apparent effects of social interaction on the consumption of NaCl solution by naive experimental subjects, in comparison with naive control subjects, in the Danguir and Nicolaidis study can be plausibly viewed as resulting from an inadequacy in the method of estimation of the amount of NaCl ingested by naive control subjects.

We had hypothesized that the observed low levels of intake of NaCl on the test day by naive control subjects was the result of hesitancy to ingest a novel salty solution the first time it was encountered. Evidence of the presence of neophobia in naive control subjects is readily available within the present paradigm. We again established trios of female rats but this time trained all members of each trio as naive control subjects. Thus, each member of each of 4 trios was (1) water deprived for 24 hr, (2) given 15 min of access to water, (3) given 24 hr of access to water, (4) water deprived for 24 hr, (5) given 15 min of access to water, (6) given 24 hr of access to water, (7) water deprived for 24 hr, and (8) given 15 min of access to NaCl. To control for the effects of social interaction on the test day (step 8) each subject was tested individually. To control for possible general aversions to ingesting a 0.9% NaCl solution steps 6, 7, and 8 were replicated after step 8 was completed.

The main results of the present study are presented in Fig. 3, which

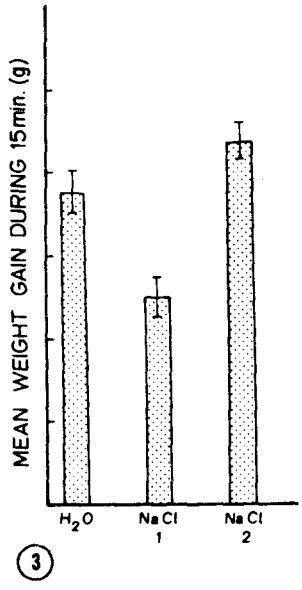

FIG. 3. Mean amount of fluid consumed, as measured by subject weight gain, by naive subjects tested alone on the second 15-min water trial, and the first and second NaCl trials. Flags indicate ±1 SE.

indicates the mean weight gain by subjects during the 15-min drinking periods represented by steps 5, 8 and 8 replicate. As would be expected if neophobia to NaCl solution was responsible for the low levels of intake exhibited by naive control subjects shown in Fig. 2, subjects in the present experiment, tested in the absence of any social interactions, exhibited a significant decrease in fluid consumption the first time they encountered NaCl solution (Mann–Whitney U test, $U = 2.5$, $P < 0.01$). Although the data presented in Fig. 3 are based on weight gains of individual subjects during 15-min drinking periods to make them comparable with the data in Fig. 2, consumption measures based on fluid loss from the drinking bottles correlated 0.96 with weight gain measures. Thus, the conclusion that naive subjects' behavior was largely determined by neophobia are equally well supported using more conventional measures of intake.

It should be pointed out that Danguir and Nicolaidis (1975) report additional evidence of the impairment of consumption in naive subjects in the seven experimental trios in which aggression was observed. The results of their post hoc analysis of the consumption of NaCl by the naive members of the five experimental trios in which no aggression was observed indicated that these animals ingested considerably more than one-third the total amount consumed by control trios. This increased con-

sumption relative to controls contrasts markedly with the apparent decreased consumption to be seen in naive members of experimental trios in which aggression was observed. As we failed to replicate this finding, we can offer no interpretation of it.

The results of the present studies suggest that the apparent difference in intake of NaCl by naive subjects in the presence of subjects trained to avoid ingesting salty solutions and those trained to ingest salty solutions, reported by Danguir and Nicolaidis, may be the result of measurement error in the determination of the amount ingested by naive subjects in the latter group. It is our conclusion that the Danguir and Nicolaidis (1975) data are neither sufficient to establish the existence of an active role of the transmitter in a social learning situation nor, as suggested elsewhere (LeMagnen, 1977, p. 233), sufficient to demonstrate the social transmission of an aversion between experienced and naive adult rats (Galef, 1977).

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