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Individual differences in responses of Norway rats to social induction of food preferences

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Abstract

Each of 36 observer rats was: (1) exposed to a demonstrator rat that had eaten an unpalatable, cayenne-pepper-flavored diet (Diet Cay), then tested to determine its willingness to eat Diet Cay and (2) exposed to a demonstrator rat that had eaten a palatable diet (Diet NPT) to which the observer had previously learned an aversion, then tested to determine its willingness to eat Diet NPT. In both instances, some observers ate substantial amounts of the diet that their respective demonstrators had eaten, while other observers did not. No consistency was found across the two situations in the relative susceptibility of individual observer rats to social influences on their food choices. In a second experiment, observer rats interacted, at 3 day intervals, with demonstrator rats that had each eaten different diets. After each interaction, all observers were given a choice test to determine their preferences for the diet that their demonstrators had eaten. Again, there was no consistency in the relative strength of individual observer rats' socially induced preferences for diets fed to demonstrators. Stable individual differences in magnitude of susceptibility to social influence on food preference did not account for a detectable proportion of observed variance in diet selection.

Key words: Food preference; Individual diference; Social learning

Introduction

Results of studies in several laboratories indicate that, after a naive 'observer' rat interacts with a conspecific 'demonstrator' that has eaten a food, the observer exhibits an

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enhanced preference for whatever food its demonstrator ate (Galef and Wigmore, 1983; Grover et al., 1988; Heyes and Durlach, 1990; Posadas-Andrews and Roper, 1983). Although such effects of foods eaten by demonstrators on the food preferences of their observers are both robust and reliable (Galef et al., 1984), in some situations there is considerable variability among observers in their responses to interaction with demonstrators; the food preferences of some observers provide clear evidence of demonstrator-induced preference enhancement, while the food preferences of other observers appear relatively unaffected by social interactions.

For example, when Galef (1986) attempted to reverse an illness-induced learned aversion (by allowing each of a group of subject rats that had learned an aversion to an otherwise palatable food to interact with demonstrator rats that had just eaten that food), some subjects ate large quantities of the averted food, while others ate almost none. Similarly, when Galef (1989) used a series of interactions with demonstrator rats that had eaten cayenne-pepper-flavored diet to induce a preference for that piquant food in observer rats, some observers exhibited an absolute preference for cayenne-flavored diet, while others continued to avoid eating it.

The present experiments were undertaken to examine the possibility that the magnitude of response of observer rats to interaction with conspecific demonstrators is a stable trait in the sense that, regardless of the test situation where susceptibility to social influence is measured, some individuals will be consistently more strongly influenced by social interactions than will others. In the course of a recent analysis of ways in which altruistic behavior may have evolved in humans, Simon (1990) proposed that some people are more 'docile' (in the dictionary meaning of the word, i.e. 'disposed to be taught') than are others. He, thus, implicitly assumed that relative openness to socially induced changes in behavior is a stable, rather than a situation-specific, characteristic of individuals.

Experiment 1

Experiment 1 was undertaken to determine whether the relative susceptibility to social influence of young rats is stable across situations (Snow, 1989) and, thus, whether previously observed variability in rats' responses to social influence might be attributed to differences in their relative docility.

Materials and Methods

Subjects

Thirty-six experimentally naive, 42-day-old, female Long-Evans rats, born in the McMaster Psychology Department vivarium to breeding stock acquired from Charles River Canada (St. Constant, Quebec), served as observers. An additional 108, 56- to 63-day-old female rats from the same source, that had served as observers in earlier experiments, but that were unfamiliar with the diets used in the present experiment served as demonstrators.

Apparatus

Observers were individually housed and tested in $22 \times 24 \times 27.5$ cm wire-mesh hanging cages throughout the 3-week duration of the experiment. Demonstrators were housed in similar cages in a room separate from that where observers were kept. Powdered food was presented to subjects in semicircular food cups (10 cm diameter).

Procedure

The experiment was conducted in two replicates each using 18 observers and 54 demonstrators as subjects. Each observer in each replicate was examined: first, to determine its susceptibility to socially induced enhancement of preference for a piquant diet (Galef, 1989) and, second, to determine its susceptibility to socially induced reversal of a learned aversion (Galef, 1985; 1986).

Study 1: Social enhancement of preference for a piquant diet. Each of 36 observer rats was offered for 23 1/2 h/day for 4 days, a choice between cocoa-flavored diet (Diet Coc: powdered Purina Rodent Laboratory Chow #5001 adulterated 2% by weight with Hershey's Pure Cocoa) and cayenne-pepper-flavored Diet (Diet Cay; powdered Purina Rodent Laboratory Chow #5001 adulterated 0.5% by weight with Donna Brand Hot Cayenne Pepper, Donna Importing Co., Mississauga, Ontario). Before Diet Coc and Diet Cay were presented to observer rats on each day of the experiment, each observer rat interacted for 30 min with a demonstrator rat that had just eaten Diet Cay for 1 h.

To make sure that demonstrator rats would eat Diet Cay when it was offered to them, on each of the 4 days of the present study, they were placed on a feeding schedule, eating Diet Cay for 1 h/day both on each of the 3 days just before Study 1 was started and during each of the 4 days of Study 1.

Study 2: Socially induced reversal of a learned aversion. One week after completion of Study 1, each of the 36 observers that had participated in Study 1 and each of 72 demonstrators were placed on a food-deprivation schedule and fed powdered Purina Rodent Laboratory Chow #5001 for 1 h/day for 2 consecutive days.

Following a third 23-h period of food deprivation, each observer was fed, for 1 h, a weighed sample of a palatable, nutritionally balanced, casein and cornstarch based diet, referred to below as Diet NPT (Normal Protein Test Diet; Teklad Test Diets, Madison, WI; catalogue number 88220).

Immediately after completion of this 1-h feeding period, each observer was injected intraperitoneally with 1% of body weight of 1% w/v LiCl solution. One hour following injection, pellets of Purina Rodent Laboratory Chow #5001 were placed in each observer's cage, and each observer was given 24 h to recover from effects of injection.

Twenty-three hours after each of the 36 observer rats had been injected with LiCl solution, the first of two demonstrator rats with which each observer was to interact was introduced into its cage for 1/2 h. Immediately after the first demonstrator was removed from each observer's cage, it was immediately replaced by a second. Both demonstrators had been fed Diet NPT for 1 h immediately before they were placed in the home cage of an observer.

At the end of the second 1/2-h period of interaction, the second demonstrator was removed from observers' cages, and observers were offered a choice, for 22 h, between weighed samples of Diet NPT and Diet Coc (see Method of Study 1 for the recipe of Diet Coc). At the end of the 22-h choice test, the experimenter weighed both food cups and determined the percentage of each observer's total intake which was Diet NPT.

Results

The main results of both Studies 1 and 2 are presented in Fig. 1 which shows a scattergram relating the percent of each observer's total intake during the 4-day test phase of Study 1 that was Diet Cay and the percent of each observer's total intake during the

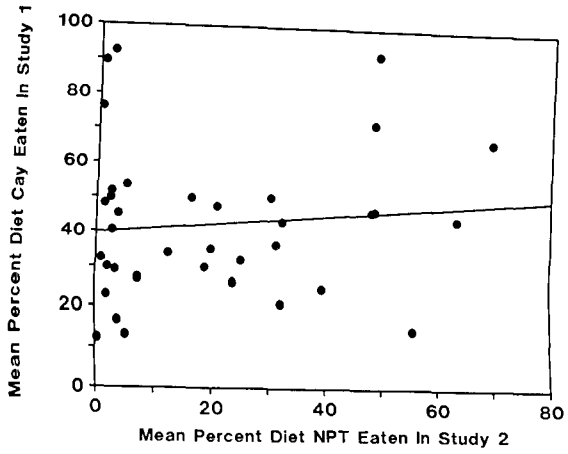

Fig. 1. Scattergram showing the relationship of individuals' mean intakes of Diet Cay during the 4 days of testing in Study 1 and their total intake of Diet NPT during the 22 h of testing in Study 2.

22-h test phase of Study 2 that was Diet NPT. As Fig. 1 shows, and as statistical test confirmed, there was no consistency between individual observers' susceptibility to social influence in Study 1 and their susceptibility to social influence in Study 2 ($r = 0.13$, $df = 35$, $P = 0.45$).

Discussion

The results of the present experiment suggest that little of the variability in response of young rats to social influences on their food choices can be attributed to stable differences in the relative susceptibility of individual rats to social influence ($r^2 < 0.02$). On the contrary, the extent to which individual rats exhibited susceptibility to social influences on their food preferences appeared to be situation specific.

The sources of this situation-specific variability in the effects of demonstrators on their respective observers' diet choices is not known: perhaps some observer rats were more affected by a given dose of LiCl and learned a stronger aversion to Diet NPT than did other observers; perhaps some observers found a given concentration of cayenne pepper more aversive than did their fellows; perhaps some demonstrators were less cooperative than were others in providing useful information to their respective observers. Whatever the sources of variation in observers' preferences for diets fed to their demonstrators in the present experiment, such variability all but completely overwhelmed individual differences in the docility of observers as a source of variance in the magnitude of social influences on diet choice.

Experiment 2

In a second attempt to provide evidence of some consistency in the susceptibility of rats to social influences on their food choices, I examined the relative susceptibility of 12 rats to social inducement to eat each of three relatively palatable but unfamiliar foods.

My co-workers and I (Galef et al., 1990) found that when observer rats were exposed to a series of demonstrators that had each eaten a different diet the observers significantly

increased their preferences for all the diets that their demonstrators ate. Thus, observer rats interacting, first, with a demonstrator fed cinnamon-flavored diet, then with a demonstrator fed marjoram-flavored diet and, last, with a demonstrator fed anise-flavored diet exhibited significantly enhanced preferences for all three diets (Galef et al., Experiment 4). In the present experiment, I used the methodology developed by Galef et al. (1990) to look for consistency in the magnitude of individual rats' responses to interaction with each of a series of demonstrators that had eaten different foods.

Materials and Methods

Subjects

Twelve experimentally naive, 42-day-old, female Long-Evans rats from the McMaster Psychology Department vivarium served as observers. An additional 36, 56- to 63-day-old female rats, that had served as observers in earlier experiments, but that were unfamiliar with all of the diets used in the present experiment, served as demonstrators.

Apparatus

The apparatus was that used in Experiment 1.

Diets

Four diets were composed by mixing powdered Purina Rodent Laboratory Chow #5001 with, respectively, 1% by weight McCormick's Fancy Ground Cinnamon (Diet Cin), 2% by weight Hershey's Pure Cocoa (Diet Coc), 2% by weight bulk ground marjoram (Diet Mar) and 1% by weight bulk ground anise (Diet Ani).

Procedure

To begin, observers and demonstrators were placed in individual cages and given 2 days to become accustomed to their enclosures. During this 2-day habituation period, all observers had ad lib access both to Diet Coc and to water.

Observers. On each of the 9 days of the experiment, each observer was offered a choice for 23 1/2 h/day between Diet Coc and another diet: on days 1 to 3, the choice offered to each observer was between Diet Cin and Diet Coc; on days 4 to 6, the choice was between Diets Mar and Coc, and on days 7 to 9, the choice was between Diet Ani and Diet Coc.

During the remaining 1/2 h of each day, food cups were weighed and refilled and, on Days 1, 4 and 7 of the experiment an unfamiliar demonstrator was placed in each observer's cage. The demonstrator introduced into each observer's cage for 1/2 h on Day 1 of the experiment had eaten Diet Cin for the preceding hour; the demonstrator introduced into each observer's cage for 1/2-h on Day 4 had eaten Diet Mar for the preceding hour, and the demonstrator introduced into each observer's cage for 1/2 h on Day 7 had eaten Diet Ani for the preceding hour.

Demonstrators. Each of the 36 demonstrators was placed on a feeding schedule for 3 days before it interacted with an observer. On each of the first 2 of the 3 days each demonstrator was food deprived for 23 h and then fed unflavored powdered Purina Rodent Laboratory Chow #5110 for 1 h. After a third 23-h period of food deprivation each demonstrator was fed the appropriate diet (either Diet Cin, Diet Mar or Diet Ani) for the hour immediately preceding its introduction into an observer's cage.

Experimenter. The experimenter determined the amount of each diet eaten by each observer during successive 23 1/2-h periods throughout the 9 days of the experiment. The experimenter then calculated: (1) the percentage of each subject's total food intake during each 23 1/2-h period that was Diet Cin, Diet Mar or Diet Ani and (2) the mean percent Diet Cin, Diet Mar and Diet Ani eaten by each subject during the 3 days that each of those diets were available.

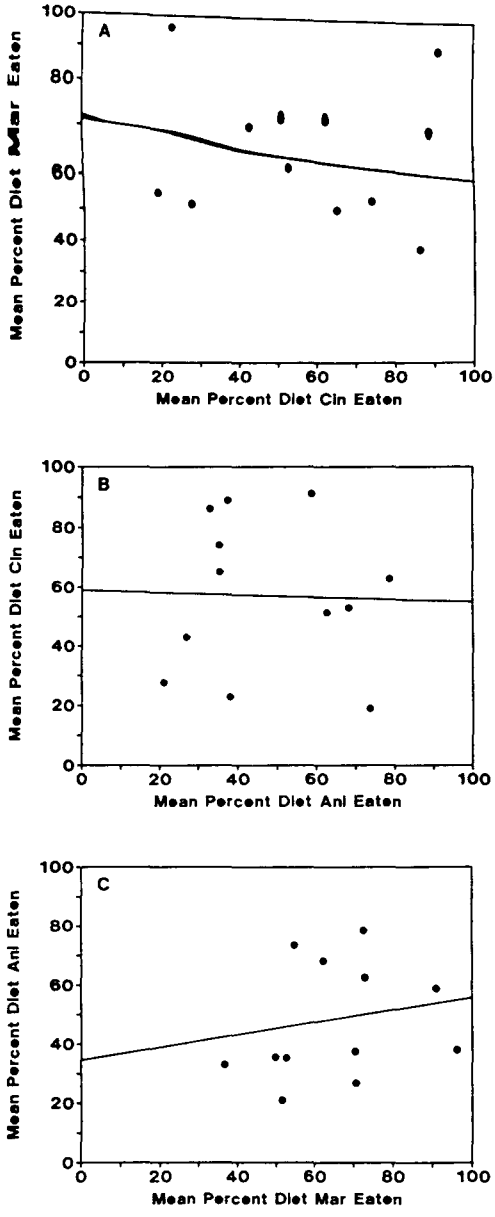

Fig. 2. Scattergrams showing the relationship of individual's mean intakes of: (**A**) Diet Cin and Diet Mar (**B**) Diet Cin and Diet Ani, and (**C**) Diet Mar and Diet Ani during successive 3-day periods in Experiment 2.

Results and Discussion

The main results of Experiment 2 are presented in Fig. 2 which shows scattergrams relating: (1) the mean percent of each observer's total intake that was Diet Cin on Days 1 to 3 with the mean percent of each observers' total intake that was Diet Mar on Days 4 to 6 (Fig. 2A), (2) the mean percent of each observer's total intake that was Diet Cin on Days 1 to 3 with the mean percent of each observer's total intake that was Diet Ani on Days 7 to 9 (Fig. 2B), and (3) the mean percent of each observer's total intake that was Diet Mar on Days 4 to 6 with the mean percent of each observer's total intake that was Diet Ani on Days 7 to 9 (Fig. 2C).

As is clear from inspection of the three panels in Fig. 2, there was no tendency for observers that ate a relatively large amount of one of the flavored-diets eaten by a demonstrator to eat large amounts of either of the other two diets eaten by demonstrators (*r*s for Fig. 2A,B and C respectively equal -0.09, -0.05 and 0.26; all *P*s n.s.)

General Discussion

The results of both Experiments 1 and 2 failed to provide evidence consistent with the hypothesis that susceptibility to social influence is a stable trait in young rats. Even within the single domain of susceptibility to social influences on food choice, the response of individual rats to interaction with demonstrators varied essentially randomly from one situation to another. Of course, this does not mean that there is no stability in rats' relative responsiveness to social influence, only that individual differences in response to social influence are small relative to other sources of variability in feeding situations. Docility does not appear to be a trait that explains a significant portion of the observed variance in rats' responses to social influences on their food choices.

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