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Learning Socially to Eat More of One Food Than of Another

Bennett G. Galef, Jr., and Elaine E. Whiskin
McMaster University, Hamilton, Ontario, Canada

Young observer rats (*Rattus norvegicus*) that interacted with a conspecific demonstrator fed a diet with more cinnamon than cocoa subsequently preferred cinnamon-flavored diet to cocoa-flavored diet, whereas observer rats that interacted with a demonstrator fed a diet with more cocoa than cinnamon preferred cocoa-flavored diet to cinnamon-flavored diet. The tendency to eat more of a food when it is a major constituent, rather than a minor one, of the diet of a conspecific may be particularly useful to weaning rats as they learn to compose a nutritionally balanced diet by eating appropriate relative amounts of several different foods.

After interacting with a recently fed conspecific (a demonstrator), a naive young Norway rat (an observer) exhibits a robust (Galef, Kennett, & Wigmore, 1984), durable (Galef, 1989; Winocur, 1990) enhancement of its intake of whatever food its demonstrator ate. Presumably, the ability to determine which foods conspecifics have eaten (Galef & Whiskin, 1992), together with a propensity to ingest similar substances (Galef & Wigmore, 1983), enhances a rat's ability to identify any valuable foods it encounters while sampling among the myriad ingestible but valueless or dangerous items that it encounters each day.

Because consumption of a nutritionally balanced diet requires that rats (like other omnivores) ingest foods in appropriate relative amounts, simply eating foods that conspecifics are eating is but a first step in the development of an appropriate pattern of food intake. Omnivores need not only eat specific foods; they must also eat appropriate relative amounts of those foods.

Experiment 1

Our previous finding that naive observer rats increase their intake of each of several different foods that a conspecific demonstrator has eaten (Galef & Whiskin, 1992), taken together with the need of rats foraging outside the laboratory to construct a diet by eating appropriate relative amounts of several different foods, led us to ask whether food selection by a rat that had interacted with a conspecific demonstrator would be affected by the relative amounts of two different foods that that demonstrator had eaten.

Construction of a nutritionally balanced diet by a naive young rat may be facilitated if it can determine which foods a conspecific had eaten in greater quantity and can use that information to adjust its own food choices.

Method

Subjects. We used as observers 100 42-day-old, experimentally naive, female Long-Evans rats (*Rattus norvegicus*) born and reared in the vivarium of the Department of Psychology, McMaster University (Hamilton, Ontario, Canada). An additional 100 50- to 57-day-old rats that had served as observers in previous experiments served as demonstrators in this experiment.

We used young female rats as subjects in both this and previous experiments on social influence on food choice (see Galef, 1988, for review) because such rats are less likely than are either male rats or sexually mature rats to behave aggressively when placed together with an unfamiliar conspecific.

All 200 subjects used in Experiment 1 were descendants of animals acquired from Charles River Canada (St. Constant, Quebec, Canada), and all had been maintained from weaning (21 days postpartum) in same-sex sibling groups of 3 or 4 that had ad libitum access to pellets of Purina Rodent Laboratory Diet 5001 (Ralston-Purina, St. Louis, MO) and water.

Procedure. Each demonstrator rat was housed in an individual, wire mesh, hanging cage (19 cm wide × 18 cm high × 34 cm long). The demonstrator was fed on a 23-hr food-deprivation schedule; that is, it was fed powdered Purina chow for 1 hr each day for 2 consecutive days.

After a third 23-hr deprivation period, we fed each demonstrator rat, for 1 hr, one of eight diets made by mixing powdered Purina chow with varying amounts of McCormick's (Hunt Valley, MD) Ground Cinnamon and Hershey's (Hershey, PA) Pure Cocoa. If a diet made by mixing both 1.25 g of cinnamon and 1.75 g of cocoa with 100 g of Purina chow is described as Diet 1.25 Cin/1.75 Coc, then the four diets fed to the 48 demonstrators assigned to Study 1 of Experiment 1 (12 demonstrators/group) were Diet 0.00 Cin/1.00 Coc, Diet 0.25 Cin/0.75 Coc, Diet 0.75 Cin/0.25 Coc, and Diet 1.00 Cin/0.00 Coc, and the four diets fed to the 52 demonstrators assigned to Study 2 of Experiment 1 (13 demonstrators/group) were Diet 1.00 Cin/2.00 Coc, Diet 1.25 Cin/1.75 Coc, Diet 1.75 Cin/1.25 Coc, and Diet 2.00 Cin/1.00 Coc. By conducting two studies we could examine the effects of a broader range of flavorant mixtures fed to demonstrators on the food choices of their observers than would have been possible in a single study, given the resources available to us.

While demonstrator rats were becoming accustomed to their feeding schedule, we placed each observer rat in an individual cage identical to those holding demonstrators (but in a room separate

Bennett G. Galef, Jr., and Elaine E. Whiskin, Department of Psychology, McMaster University, Hamilton, Ontario, Canada.

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Correspondence concerning this article should be addressed to Bennett G. Galef, Jr., Department of Psychology, McMaster University, Hamilton, Ontario L8S 4K1, Canada. Electronic mail may be sent to Galef@McMaster.CA.

from them) and left the observers undisturbed for 3 days, with ad libitum access to water and pellets of Purina chow, to become familiar with the experimental situation.

Immediately after each demonstrator's third 1-hr feeding period, we placed it in the cage of an observer and then left demonstrator and observer to interact for 30 min.

Once the 30-min period of interaction between demonstrators and observers was completed, we removed demonstrators from the experiment and offered each observer a choice, for 23-hr, between weighed samples of two diets made by mixing either 1.00 g of cinnamon (Diet 1.00 Cin) or 1.00 g of cocoa (Diet 1.00 Coc) with 100 g of powdered Purina chow.

At the end of the 23-hr period of choice, we determined the amount of Diet 1.00 Cin and Diet 1.00 Coc each observer had eaten, then calculated the proportion of each observer's total intake that was Diet 1.00 Cin. We discarded data from 2 observers whose demonstrators had failed to eat 2 g of food during the 1-hr feeding period immediately before their interaction with observers.

Results and Discussion

As can be seen in Figure 1, in both Studies 1 and 2 of Experiment 1, there was a significant effect of the diet fed to demonstrators on the diet preferences exhibited by their respective observers: Study 1, $F(3, 43) = 6.73$, $p < .001$, and Study 2, $F(3, 47) = 3.52$, $p < .03$. Furthermore, observers in Study 1 that interacted with demonstrators fed Diet 0.75 Cin/0.25 Coc ate significantly more Diet Cin during testing than did observers that interacted with demonstrators fed Diet 0.25 Cin/0.75 Coc, Bonferroni multiple comparisons test, $t(21) = 2.11$, $p < .05$, and observers in Study 2 that interacted with demonstrators fed Diet 1.75 Cin/1.25 Coc ate significantly more Diet Cin during testing than did observers that interacted with demonstrators fed Diet 1.25 Cin/1.75 Coc, Bonferroni multiple comparisons test, $t(23) = 2.04$, $p < .05$. In sum, during testing, observer rats ate more of a diet when it had a flavor that was at relatively high concentration in the food that their respective demonstrators had eaten than when it had a flavor that was at relatively low concentration in the diet that their respective demonstrators had eaten.

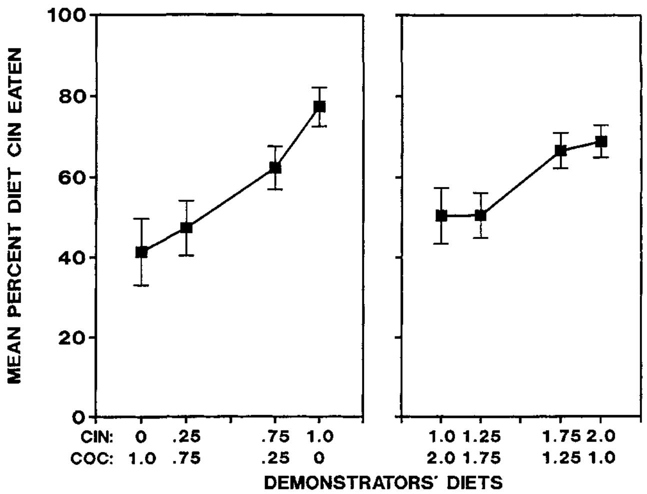

Figure 1. Mean percentage of Diet 1.00 Cin eaten during a 23-hr choice test by observer rats in Study 1 (left panel) and Study 2 (right panel) of Experiment 1 whose demonstrators ate diets with varying amounts of cinnamon and cocoa (indicated on the abscissa in g/100g of Purina chow). Flags = ± 1 SEM.

Experiment 2

Experiment 2 was undertaken to determine whether the differing responses of observer rats to different concentrations of cinnamon and cocoa in the diet eaten by their respective demonstrators found in Experiment 1 were the result of a correlation between the concentration of a single flavorant in a diet and the magnitude of socially induced preference for that flavorant. To this end, in Experiment 2, we examined the intake of Diet 1.00 Cin and Diet 1.00 Coc by observer rats whose demonstrators had eaten diets with varying concentrations of either cinnamon or cocoa.

Method

The method of Experiment 2 was identical to that of Experiment 1, with the exception that we fed the 72 demonstrators assigned to Study 1 (9 demonstrators/group) either Diet 0.25 Cin, Diet 0.50 Cin, Diet 0.75 Cin, Diet 1.00 Cin, Diet 0.25 Coc, Diet 0.50 Coc, Diet 0.75 Coc, or Diet 1.00 Coc and the 66 demonstrators assigned to Study 2 of Experiment 2 (11 demonstrators/group) either Diet 1.00 Cin, Diet 1.50 Cin, Diet 2.00 Cin, Diet 1.00 Coc, Diet 1.50 Coc, or Diet 2.00 Coc. As in Experiment 1, each of the 138 observers in Experiment 2 interacted with a different demonstrator and was then individually tested for 23 hr to determine its preference between Diet 1.00 Cin and Diet 1.00 Coc.

We discarded data from 5 observers whose demonstrators failed to eat during the 1-hr feeding period immediately before their interaction with their respective observers.

Results and Discussion

The results of Experiment 2 were not consistent with the hypothesis that concentration of flavorant in a food fed to a demonstrator rat influenced the magnitude of the preference induced in its observer for a food with that flavorant. As can be seen in Figure 2, within the range of concentration of flavorants used in Experiment 2 (the same range of concentrations of flavorants used in Experiment 1), there was no effect of the concentration of either cinnamon or cocoa fed to demonstrator rats on the magnitude of the flavor preferences induced in their respective observers: for cinnamon-flavored diets, $F(5, 51) = 0.41$, *ns*, and for cocoa-flavored diets, $F(5, 55) = 0.31$, *ns*. Consequently, the finding in Experiment 1 of a response on the part of observer rats to the relative concentrations of cinnamon and cocoa in foods fed to their respective demonstrators cannot be explained as a result of simple additive effects of the magnitude of preferences induced in observers for cinnamon and cocoa by different concentrations of those flavorants in their respective demonstrators' diets. Rather, diet selection by observer rats in Experiment 1 appears to have reflected the relative intensity of odors that observers detected on the

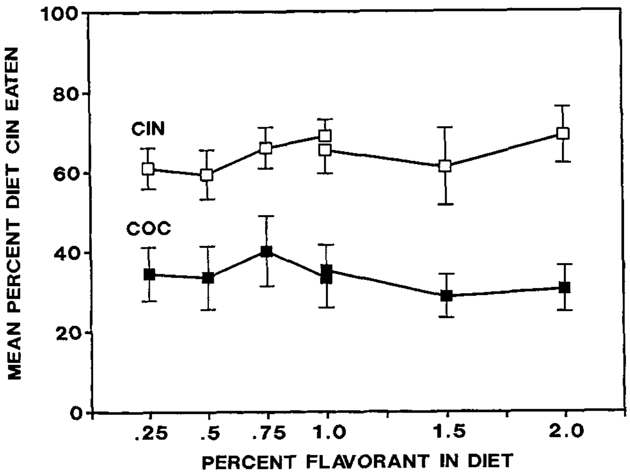

Figure 2. Mean percentage of Diet 1.00 Cin eaten during a 23-hr choice test by observer rats in Studies 1 and 2 of Experiment 2 whose demonstrators ate diets with varying amounts of either cinnamon or cocoa. Flags = ± 1 SEM.

breath of their respective demonstrators (Galef & Stein, 1985).

General Discussion

During a brief period of interaction with a recently fed conspecific, observer Norway rats learned more than the identity of the foods that their respective demonstrators had eaten (Galef & Whiskin, 1992). Observer rats also detected which of two flavors predominated in the food eaten by their respective demonstrators' and ate more of a food when it had a flavor that was in relatively high concentration than when it was in relatively low concentration in their respective demonstrators' diets.

The tendency of young rats choosing between foods to ingest more of a food with the same flavor as a food that conspecifics ate in relatively large quantities than of a food that conspecifics ate in relatively small quantities may be particularly helpful to weaning rats as they learn to compose nutritionally balanced diets by consuming appropriate relative amounts of several different foods.

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