SHORT REPORTS

Food carrying determined by eating time of a food in rats (*Rattus norvegicus*)

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The present study was conducted to find whether eating time is one of the most important determinants of food carrying using young rats of different ages, whose eating time was expected to be longer than that of adult rats. As eating time got shorter with the rats' body growth, food carrying systematically decreased. It was clearly shown that eating time played a major role in the choice of food carrying in rats. There seems to be a certain length of eating time as a criterion for the selection of eating or carrying, regardless of the age of the rats.

Rats encountering food have to choose one of two behaviors: eating it at the place where the food is found or carrying it to their nest or other refuges. It has been reported that rats eat smaller foods at the place where they are found but carry larger foods to the nest or refuges, and the probability of carrying increases gradually as food size increases (Nakatsuyama & Fujita, 1995; Phelps & Roberts, 1989; Whishaw & Tomie, 1989).

Whishaw (1990) suggested that the eating time of food is one of the major determinants of carrying. Eating time must play an important role in a foraging trip, because the more time rats need to eat a food outside the nest, the more they expose themselves to predators—that is, they run a greater risk of predation (Lima, Valone, & Caraco, 1985).

The body size of the juvenile rat is much smaller than that of the adult rat, which means that juvenile rats should need more time, relative to that needed by adult rats, to consume food of the same size. If eating time is a major determinant of carrying, as Whishaw (1990) has suggested, and if the eating-time reference is kept unchanged throughout rats' lives, then juvenile rats should choose to carry more various-sized foods, which adult rats do not. The present experiment was conducted in order to examine this possibility.

METHOD

Subjects

The subjects were Wistar-Imamichi rats maintained at the University of Tsukuba. For the *eating-time test*, 10 females and 10 males were used. For the *carrying test*, 8 females and 8 males were used. They were housed on a 12:12-h light:dark schedule (8:00 a.m. on, 8:00 p.m. off). Both tests were conducted between 1:00 p.m.

and 5:00 p.m. The rats were placed inside the individual compartment, and they stayed there for 23 h without food until the test.

Food Materials

The food materials were 0.045 g pellets (Muromachi Co., Japan) and 0.1 and 0.2 g cut laboratory chow (Oriental Co., Japan).

Eating-Time Test

Apparatus. Four wire-meshed cages (75 × 21 × 17 cm) divided into five compartments were used for the test. A glass food cup, 1 cm in depth and 3 cm in diameter, was placed inside each compartment (15 × 21 × 17 cm).

Procedure. One of the three different-sized foods was put into a food cup in the compartment. Eating time was measured in seconds. The rats ate all three different-sized foods in random order approximately every 10 min in a test session. The session was repeated once a week, when the rats were 5–8 weeks of age and 12 weeks of age.

Carrying Test

Apparatus. An elevated straight alley (200 cm long, 10 cm wide, with 2-cm-high sidewall) made of gray polyvinylchloride was used. There was a dent (1 cm in depth, 3 cm in diameter) at the end of the alley as a food site. The startbox (20 × 20 × 30 cm), which was made of the gray polyvinylchloride, was attached to the other end. The rats could travel the alley through a small hole (10 × 7 cm). The open alley was illuminated about 200 lx and the startbox was illuminated about 50 lx.

Procedure. The rats were left in the alley for 20 min daily with plenty of the three different-sized foods scattered for 14 days, when the rats were 3–4 weeks of age.

A round trip, in which the rat left the startbox, found food at the food site, and came back to the startbox with the food in the mouth or after eating it at the site, was regarded as one trial. Five trials were repeated with each of the three different-sized foods in random order on a day session (15 trials), when the rat was of 5, 6, 7, and 8 weeks of age; thus, each rat experienced a total of 60 trials. The order of presentation of food size was counterbalanced among and within rats.

RESULTS AND DISCUSSION

Eating-Time Test

Eating time naturally became shorter as the rats grew, as shown in Figure 1 [$F(1, 18) = 85.25, p < .01$], and males

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Figure 1. Mean percent incidence of food carrying plotted against eating time obtained from the eating-time test for each of three different-sized foods (0.045, 0.1, and 0.2 g) at each age of the rats. The open and closed symbols represent female and male, respectively; wk stands for weeks of age. To compare the results of the rats 5–8 weeks of age with the carrying incidences of adult rats 12 weeks of age, we included results from Nakatsuyama and Fujita (1995) plotted against the eating-time results obtained in this experiment.

ate foods significantly faster than females [$F(1,18) = 12.28, p < .01$]. Obviously, smaller young and female rats needed more time to finish eating the same-sized food than did the adult and male rats.

Carrying Test

The carrying of 0.045- and 0.1-g food was found to decrease with age [$F(1,14) = 12.53, p < .01$], whereas that of 0.2-g food was higher regardless of age. Younger rats showed a much higher rate of choice for carrying any size of food than did 12-week-old adults (Nakatsuyama & Fujita, 1995). An overall gender difference in carrying was found [$F(1,14) = 5.29, p < .05$]. Females of every age chose carrying with a consistently higher rate (more or less) for every size of food than did males. These results are in line with earlier results (Nakatsuyama & Fujita, 1995).

The relationship between food carrying and eating time is clearly shown in Figure 1. Food carrying was chosen more as a function of eating time regardless of age, food size, or gender.

Smaller juveniles, however, might be more susceptible and sensitive to robbery of food by conspecifics and to the threat of predators (Whishaw & Whishaw, 1996). If this is the case, juveniles should be more likely than adults to

choose to carry the food that takes them almost the same time to eat. Since there was no discrepancy between the juveniles and the adults in the relationship between eating time and carrying probability, the present results suggest that there is no difference in risk sensitivity between young rats and adult rats.

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