Atti Accademia Nazionale dei Lincei

Classe Scienze Fisiche Matematiche Naturali

Rendiconti

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Food preferences in mice: an analysis using wheat, rice, chrysalis flour and commercial food pellets

Atti della Accademia Nazionale dei Lincei. Classe di Scienze Fisiche, Matematiche e Naturali. Rendiconti, Serie 8, Vol. **61** (1976), n.6, p. 635–640.

Accademia Nazionale dei Lincei

<http://www.bdim.eu/item?id=RLINA_1976_8_61_6_635_0>

Atti della Accademia Nazionale dei Lincei. Classe di Scienze Fisiche, Matematiche e Naturali. Rendiconti, Accademia Nazionale dei Lincei, 1976.

SEZIONE III

(Botanica, zoologia, fisiologia e patologia)

Zoologia. — *Food preferences in mice: an analysis using wheat, rice, chrysalis flour and commercial food pellets* (*). Nota di MARISA MAINARDI, STEFANO PARMIGIANI, DAVIDE CSERMELY e ANTONIO PASQUALI, presentata (**) dal Socio S. RANZI.

RIASSUNTO. — Sono stati compiuti due esperimenti per studiare le preferenze alimentari del topo domestico (*Mus musculus*) allo scopo di osservare se esperienze alimentari precedenti possano influenzare le scelte successive. Sono state perciò allevate delle nidiate di animali divise in due gruppi e nutrite rispettivamente con un solo tipo di seme: riso o frumento. Sia gli adulti di partenza che i giovani allevati sono stati sottoposti a un test di scelta binaria tra i due alimenti in esame. Questa parte dell'esperimento si è basata sulle risposte di 98 animali.

Nella seconda parte è stato effettuato un esperimento analogo dove però gli alimenti erano una dieta commerciale semplice e la stessa dieta commerciale addizionata con farina di crisalide di baco da seta (*Bombix mori*). I dati in questo caso riguardano 110 animali.

Gli esperimenti hanno mostrato come talune scelte siano condizionate dall'effetto di stimoli di natura alimentare che abbiano agito precedentemente sull'individuo (è il caso di riso e frumento), mentre altre sembrano essere indipendenti (è il caso della farina di crisalide di baco da seta).

The behaviour involved in food choice may, in many cases, express an interaction between the genotype and the animal's previous experiences [1, 2]. Hess's experiments [3] on chicks (*Gallus gallus*) also confirm the reinforcement of food preferences derived from early experience. The tendency within the same species to retain a preference for a known food has also been reported by Burghardt [4]. In different ways and to different extents the phenomenon appears in several species, such as the snapping turtle *Chelydra serpentina* [5], snakes *Thamniophis sirtalis* [6], chicks [7], gulls of the species *Larus argentatus* and *Larus delawarensis* [8], guinea-pigs [9], rats *Rattus norvegicus* [10, 11, 12] and mice *Mus musculus* [13].

Food preferences in mice *Mus musculus* have been analysed by D. Mainardi, M. Mainardi, Parmigiani and Pasquali [14] at the level of binary choice between wheat and barley seeds. The behaviour of both groups fed on normal diets and those fed on controlled diets was sampled. The results showed how in the test situations sampled the preference went consistently to wheat, but that previous alimentary experiences may influence subsequent food preferences.

(*) Supported by a grant of the Consiglio Nazionale delle Ricerche.

(**) Nella seduta dell'11 dicembre 1976.

In the present experiment, the same research has been carried further, this time analysing the effect of previous experience on food preference for rice (*Oryza* sp.) and wheat (*Triticum* sp.) which are both highly desirable gramineae [15].

The same phenomenon was also studied, but this time an attempt was made to see how a food preference may be affected by experience with a food which, presumably, does not normally occur in the diet of the animal in question. We chose silk-worm chrysalis flour (*Bombix mori*) which has a strongly characteristic smell and which mice consume in small quantities when it is added to their diet.

We used albino mice and an apparatus consisting of a series of 10 containers $70 \times 70 \times 50$ cm. In addition to cotton wool for the nest and a drinking tray, in each of these containers there was a plastic structure made up of two seed trays $6 \times 3 \times 3$ cm. Incorporated into this structure was a light-resistance device (photo-electric cell) connected to two electromagnetic counters that could be reset at zero. The wires were passed through a central tube. The whole apparatus was connected to a power supply (Plate I, fig. 1 *a*, *b*; Plate II, fig. 1 *a*). Every time the animal put its muzzle into one of the seed trays the counter recorded a click (Plate II, *b*). The test for choice consisted in leaving the animal which had not been fasted by itself in the container for 24 hours. The information regarding the animal's food choice was drawn from the number of clicks registered in the 24 hours.

For the part of the experiment concerning the choice between rice and wheat we used 50 animals, 25 males and 25 females. These animals were tested for choice on two occasions with a week's interval between the two tests. At the same time, five groups of 3 males and 8 females were kept in boxes. These animals served to provide subjects which had been raised on a controlled diet. In fact as the females became pregnant, they were isolated in groups of 3 and fed only on rice or only on wheat according to the group and in addition they always received carrots and water. This procedure was adopted on the grounds that conditioning through milk may occur, as has been observed for rats [16]. The offspring continued to be fed in this way until the moment of testing, i.e. when the animal was between 50 and 60 days old. When testing adults the seeds were presented whole, for the young the food was milled into wheat or rice flour and sieved.

With regard to the experiment on the choice between silk-worm flour and commercial food pellets, we used 25 males and 25 females and adopted the same experimental procedure as above except that these animals, immediately after the two tests (a week apart as before) were randomized and boxed in couples. Of these 15 were fed on milled food pellets mixed with chrysalis flour (in proportions of 55 % and 45 % respectively), while the other 10 couples were fed exclusively on commercial food pellets.

The offspring of these couples were fed on the same diet as their parents and were presented with the choice test when they were between 50 and 60 days old.

In the first part of the experiment (wheat v. rice), the data recorded are expressed in percentages of clicks registered for wheat during the 24-hour stay in the containers.

For the 50 adult animals in the first test, the average number of clicks registered was 67.19. These animals were then fed on the commercial diet for a week and submitted to the second test. This time the average number of clicks was 56.69; this means therefore that there was a highly significant decrease in the preference for wheat ($t = 2.94$; $p < 0.01$) (Table I and II).

EXPERIMENT RICE v. WHEAT

TABLE I.

Average score obtained in the various trials (% of clicks in wheat tray).

Groups	No. of animals	Average score	Standard error
Adults trial 1	50	67.19	2.54
Adults trial 2	50	56.69	2.52
Young fed on rice	19	64.63	7.36
Young fed on wheat	29	41.66	6.50

TABLE II.

Comparisons made between the different groups under examination.

Comparisons	No. of animals	t	P
Adults trial 1 – Adults trial 2	50–50	2.94	< 0.01
Young fed on rice – Young fed on wheat	19–29	2.30	< 0.05

It should be noted that the difference in choice in the two tests a week apart also appeared in trials with wheat v. barley; there the preference for wheat, a food preferred from the start, increased. Here too, the results pointed in the same direction, in fact, although both foods in question are highly desi-

rable (wheat and rice), in certain cases rice appeared to be slightly more desirable [15].

The young mice (50 to 60 days old) were then sampled. They had been fed on a controlled diet since the mother's pregnancy. The results (Table I) showed: *a*) for the animals fed on rice an average of 64.63 clicks, 19 animals tested; *b*) for the animals fed on wheat, an average of 41.66 clicks, 29 animals tested. If these averages are compared, it can be seen that there is a considerable difference in that the animals fed on rice tend to prefer wheat and those fed on wheat tend to prefer rice. This difference is statistically significant ($t = 2.30$; $p < 0.005$). It is clear therefore, that in this case previous experience influenced the choice.

In the second part of the experiment the comparison concerned the entirely commercial diet and that mixed with chrysalis flour. Here the data are expressed as percentage of clicks recorded in favour of the diet containing chrysalis flour (Table III–IV).

EXPERIMENT FOOD PELLETS v. CHRYSALIS FLOUR

TABLE III.

Average score obtained in the various trials (% of clicks in chrysalis flour tray).

Groups	No. of animals	Average score	Standard error
Adults trial 1	50	35.53	2.14
Adults trial 2	47	29.16	1.63
Young fed on food pellets	30	35.74	2.13
Young fed on food pellets-chrysalis flour	30	33.48	3.08

TABLE IV.

Comparisons made between the different groups under examination.

Comparisons	No. of animals	*t*	P
Adults trial 1 – Adults trial 2	50–47	2.34	< 0.05
Young fed on food pellets – Young fed on food pellets–chrysalis flour	30–30	0.60	> 0.05

The 50 adult mice used were submitted to the first choice test. The average number of clicks recorded was 35.53. After a week of commercial diet (3 animals died in the meantime) the animals were re-tested and the result was an average of 29.16 clicks. The tendency to consume chrysalis flour decreased significantly ($t = 2.34$; $p < 0.005$). In this case also, after a certain period of time there was a tendency towards an increased preference for a food already preferred from the start (Table III and IV).

The last set of data concerns the food preferences in the offspring of those individuals fed using the technique described above on different diets from the start of the mother's pregnancy.

When considering these animals' choices, it can be observed that for those fed on food pellets there was an average of 35.74 clicks and for those fed on the diet mixed with chrysalis flour it was 33.48. Just a quick glance at these averages shows that they are very similar and in fact they are not statistically significant ($t = 0.60$; $p > 0.05$). It therefore seems that chrysalis flour of *Bombix mori* does not represent a stimulus capable of influencing subsequent food choices, unlike what was previously seen for some gramineae.

To conclude, the experiments here described show that there are food stimuli capable of influencing food choices in mice, but that not all food stimuli have this effect.

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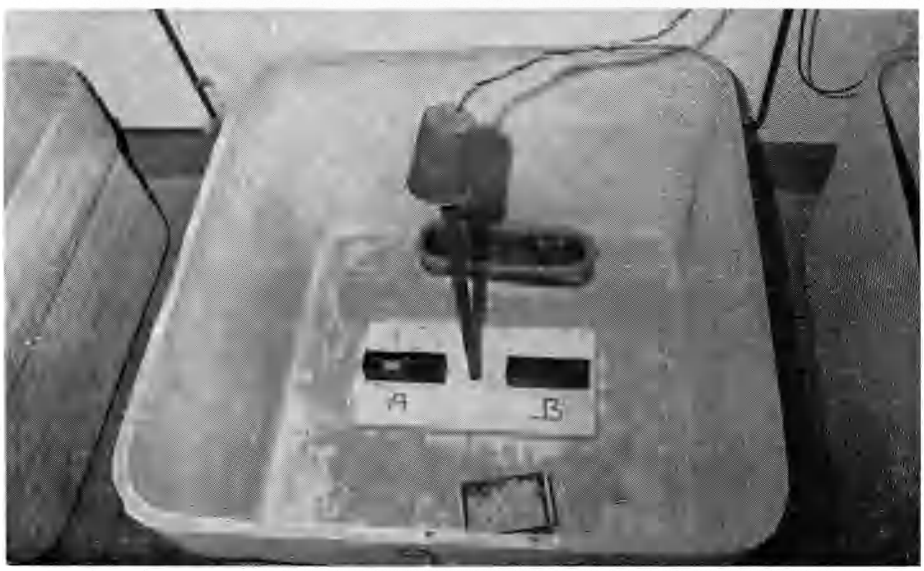
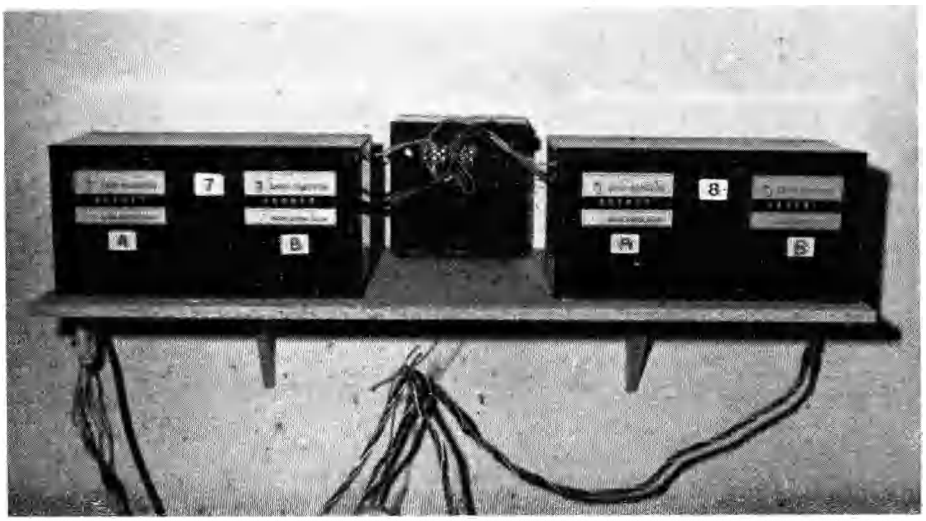
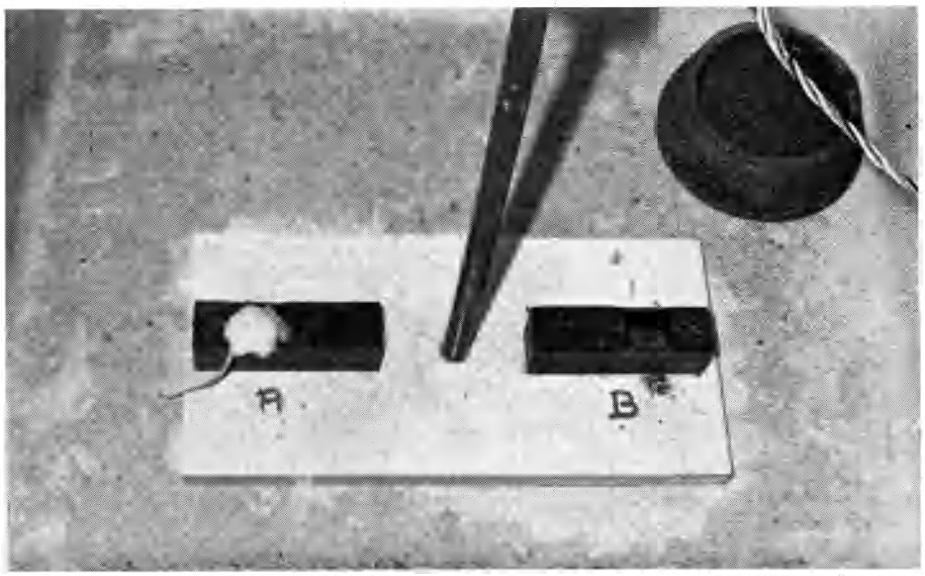
a) The whole apparatus.



b) A single container.



a) Electromagnetic counters.



b) Food choice of a mouse.