measures. The failure to demonstrate facilitation in Group H on the response ratio and criteria measures is most likely explained by the small group size, analysis of response ratios over only 18 sessions in the present study, as compared to 33 sessions in the original study, and the necessarily low performance-level criteria used.

The severe cortical deficit, as measured by response ratios and criteria measures, and the absence of a cortical deficit (compared to Group N), as measured by latency ratios, also confirm the results of our previous study. It should be pointed out that although the hippocampal group had essentially the same cortex removed as the cortical group, facilitation was still observed. Hippocampectomy either eliminated or compensated for the functional disruption produced by cortical destruction. During evaluation of the histology, it was noticed that the cortical destruction in the animals in the present experiment was more lateral than in the previous study. An investigation is under way, attempting to define the location and extent of cortical destruction involved in producing the observed deficit in go/no-go acquisition.

The present experiment provided no clear evidence that hippocampectomized rats attended to the redundant SD less than did cortically ablated or normal rats, as measured by performance changes following SD removal. However, the SD may have been introduced too soon (before alternation cues began to be utilized by any group) or too late (after all groups had begun to utilize alternation cues) for an adequate test of the attention hypothesis that was tentatively proposed. It should be noted, however, that two of

the rats in the cortical group only began to show improvement after the SD was introduced. Thus, the authors feel that the attention hypothesis stated above cannot be dismissed on the basis of the present study.

The previous (Brown et al, 1969; Means et al, in press) and present results are inconsistent with either a memory hypothesis (see Milner, 1968) or response inhibition hypothesis (see Douglas, 1967 and Kimble, 1968) of hippocampal function. The hippocampal group was able to inhibit responses on nonreinforced no-go trials as well (response ratio) as or better (latency ratio) than normal animals. The hippocampus, thus, apparently is not necessary for response inhibition in this task, nor does hippocampectomy produce a response inhibition deficit. On the other hand, the severe cortical deficit in the ability to withhold responses on no-go trials found in the present and previous (Means et al, in press) experiments suggest that the postero-lateral cortex overlying the hippocampus does subserve a response inhibition function.

REFERENCES

- BROWN, T. S., KAUFMAN, P. G., & MARCO, L. A. The hippocampus and response perseveration in the cat. *Brain Research*, 1969, 12, 86-88.
- DOUGLAS, R. J. The hippocampus and behavior. *Psychological Bulletin*, 1967, 67, 416-442.
- KIMBLE, D. P. The hippocampus and internal inhibition. *Psychological Bulletin*, 1968, 70, 285-295.
- MEANS, L. W., WALKER, D. W., & ISAACSON, R. L. Facilitated single alternation go, no-go performance following hippocampectomy in the rat. *Journal of Comparative & Physiological Psychology*, in press.
- MILNER, B. Disorders of memory after brain lesions in man. *Neuropsychologia*, 1968, 6, 175-179.

Flavor preferences in laboratory rats*

FRED P. VALLE

University of British Columbia, Vancouver 8, Canada

One group of rats (Group A-B) was reared on an almond-flavored diet, a second group (Group B-A) on a banana-flavored diet, and a third group (Group C-C), on an unflavored diet. The groups were then given both the banana and almond diets for 2 days. Results showed all three groups preferred almond to banana (almond preference), with Group B-A showing the strongest preference (novelty preference). Results of a second set of tests, following upon an interval during which Groups A-B and B-A had their maintenance flavors switched, were generally consistent with the above but also indicated that a diet's preferability may depend upon an interaction between its primacy, its familiarity, and its attractiveness.

Bronson (1966) reports that laboratory rats that have been fed one type of food

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from infancy fail to show a preference for that food when given a choice between it and a novel diet. In fact, Bronson's Ss showed an initial preference for the novel diet. Welker & King (1962) also report that

laboratory rats prefer the more novel of two standard types of laboratory chow [see Galef (1970) for information concerning feral rats].

The present study was undertaken partly to develop a procedure for producing a multiflavored diet and partly to replicate the findings of the earlier studies, with the addition of a "control" group for which each of the two test diets was novel.

SUBJECTS

The Ss were 31 Long-Evans-derived rats bred in the psychology colony at the University of British Columbia.

PROCEDURE

On the basis of pilot observations, the following procedure was developed for preparing flavored diets. Purina rat pellets were ground into powder and 500 g of this powder was mixed with 100 ml of Mazola oil. This produced a slightly cohesive food mixture that was resistant to spillage. Three different flavors of food were then prepared by (1) leaving the food mixture unadulterated or (2) adding 5 ml of either banana food flavoring or almond food flavoring to 40 g of the food mixture.

As soon as it was determined that three female rats were pregnant, each female was placed on one of the three diets. Hence, one female, whose litter of seven is hereafter referred to as Group C-C, was fed the basic unflavored food mixture. A second female, whose litter of 12 comprised Group A-B, was put on the almond-flavored diet. The third female, whose litter of 12 comprised Group B-A, was placed on the banana-flavored diet.

The females and pups were maintained on these diets following parturition and throughout the rearing period. Following weaning at 21 days, when they were placed in individual cages, the pups were maintained on the diets for an additional 15 days. All Ss were then given *both* the banana and almond diets (40 g of each) for 2 consecutive days, with a daily record kept of the amount of each diet S consumed. These 2 days are referred to as Tests 1 and 2.

Following these tests, the Group C-C Ss were again maintained on the unflavored diet. The Group A-B Ss were switched from the almond diet to the banana diet. And the Group B-A Ss were switched from the banana diet to the almond diet. These conditions were continued for 15 days following which another 2-day choice period (Tests 3 and 4) was given.

RESULTS

The results are expressed as preference ratios of the form $A/(A+B)$, where A refers to the grams of almond-flavored food consumed on the test day and B refers to the grams of banana-flavored food consumed. The mean preference ratios for

Fig. 1. Preference ratios for three groups of rats given a choice between a banana-flavored diet and an almond-flavored diet. For each S the preference ratio was derived from the number of grams of almond-flavored diet consumed, relative to the total number of grams consumed during each 24-h test. Group A-B was maintained on the almond-flavored diet prior to Tests 1 and 2 and then switched to the banana-flavored diet prior to Tests 3 and 4. Group B-A was maintained on the banana-flavored diet prior to Tests 1 and 2 and on the almond-flavored diet prior to Tests 3 and 4. Group C-C was maintained on an unflavored diet prior to both sets of tests.

the three groups for all four tests are shown in Fig. 1. From Fig. 1 it can be seen that there is both an "almond" effect, that is, all three groups preferred almond on the first two tests, and a "novelty" effect, that is, the almond effect was accentuated if almond was also the novel diet and attenuated if almond was the familiar diet.

Statistical analyses of these effects were done for each of the 4 test days. For each day, *t* tests were first computed to determine if each group's preference ratio differed significantly from .5. An analysis of variance was then computed to determine if there was a reliable

between-groups difference in preference. If there was a reliable effect, a Dunnett's test was used to compare the control group (Group C-C) with each of the other two groups. Finally, the performance of Group A-B was compared with that of Group B-A by the use of a simple contrast.

Test 1

All three groups showed a reliable preference for almond, as indicated by *t* tests. (All *t* tests reported as reliable in this study are reliable at or beyond the .01 level.) The analysis of variance, moreover, showed a significant between-groups effect: $F = 6.01$, $df = 2/28$, $p < .01$. Dunnett's test did not indicate a reliable difference between Group C-C and either of the other two groups. Group B-A, however, showed a significantly greater preference for almond than did Group A-B: $F = 11.97$, $df = 1/28$, $p < .01$.

Test 2

All three groups still preferred almond to banana. Analysis of variance, however, did not show a significant between-groups effect: $F = 1.02$.

Test 3

Application of *t* tests indicated that Group A-B reliably preferred almond and Group B-A reliably preferred banana. Group C-C showed no reliable preference. Consistent with this pattern, analysis of variance indicated a significant between-groups effect: $F = 43.13$, $df = 2/28$, $p < .001$. Dunnett's test showed that Group C-C differed reliably ($p < .05$) from both Group A-B and Group B-A. Group A-B showed a significantly greater almond preference than did Group B-A: $F = 84.08$, $df = 1/28$, $p < .001$.

Test 4

Application of *t* tests showed that Group B-A had a reliable preference for banana. Neither of the two remaining groups had a reliable flavor preference. Analysis of variance indicated a significant between-groups effect: $F = 5.25$, $df = 2/28$, $p < .05$. Dunnett's test did not indicate a reliable difference between Group C-C and either of the other two groups. Group A-B and Group B-A differed reliably from each other: $F = 10.39$, $df = 1/28$, $p < .01$.

DISCUSSION

An almond effect is clearly demonstrated on Test 1; all three groups preferred almond to banana. The presence of a novelty effect on Test 1 is suggested by the fact that Group B-A, for which almond was the novel diet, showed a significantly greater almond preference than did Group A-B, for which almond was the familiar diet.

A novelty effect is also shown on Test 3. Here, after 2 weeks on an almond diet, Group B-A showed a preference for banana, while Group A-B, after 2 weeks on a banana diet, showed a preference for almond. The control Ss showed no reliable flavor preference. Even this lack of a preference, however, is consistent with a "novelty" hypothesis and can be interpreted as indicating that the almond preference shown by the control Ss on Tests 1 and 2 was effectively counteracted by a novelty preference on Tests 3 and 4 (banana was relatively novel to the control Ss since they ate relatively little of it on Tests 1 and 2).

It is clear that there is no direct evidence in the present study for an early diet preference. The only suggestion of such an effect lies in the fact that on Tests 3 and 4, Group B-A showed a significant preference for their early diet, banana. At least part of this banana preference, following upon 2 weeks of an almond diet, can be interpreted as a novelty preference, and in light of previous failures to obtain early-diet preferences (Bronson, 1966), a novelty interpretation appears to be the most parsimonious explanation. It is curious, however, that Group A-B did not show a comparable novelty preference for banana on Tests 1 and 2.

In short, the preferability of a diet appears to be determined by an interaction between its *primacy*, *familiarity*, and *attractiveness*. Group A-B would not choose a novel, less attractive diet over a familiar, more attractive diet (Tests 1 and 2), but Group B-A would choose a primal (but now somewhat novel), less attractive diet over a familiar, more attractive diet (Tests 3 and 4). Presumably, the extent of this asymmetry might be determined by such factors as the degree of difference in attractiveness between the two diets, the length of the pretest maintenance period, and perhaps the deprivation state of the S. These possibilities appear deserving of further study.

REFERENCES

- BRONSON, G. Evidence of the lack of influence of early diet on adult food preferences in rats. *Journal of Comparative & Physiological Psychology*, 1966, 62, 162-164.
- GALEF, B. G., JR. Aggression and timidity: Responses to novelty in feral Norway rats. *Journal of Comparative & Physiological Psychology*, 1970, 70, 370-381.
- WELKER, W. I., & KING, W. A. Effects of stimulus novelty on gnawing and eating by rats. *Journal of Comparative & Physiological Psychology*, 1962, 55, 830-842.