Journal of Comparative and Physiological Psychology
1969, Vol. 67, No. 4, 516-521

PREFERENCE FOR FAMILIAR VERSUS NOVEL STIMULI AS A FUNCTION OF THE FAMILIARITY OF THE ENVIRONMENT[1]

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The effect of high and low levels of environmental novelty on the direction of response to novel stimuli was tested by placing rats in a strange environment where they had the choice of approaching a source of familiar stimulation or a comparable novel one. On first exposure *Ss* significantly preferred the familiar stimulus, but after habituation to the environment *Ss* changed to significant preference for novel stimuli. A subsequent increase in novel stimulation tended to change preference back to familiar stimuli. These findings support the previously untested optimal-level hypothesis of novelty response.

When an animal is exposed to a novel stimulus it may approach the stimulus or it may show avoidance and retreat. What are the conditions that determine which response will occur?

Many recent laboratory studies imply that approach is the common response to novel stimuli. These data have been summarized by Berlyne (1960), Fowler (1965), Welker (1961), and others. However, many field studies and some laboratory work suggest that novelty avoidance is the more common response (Barnett, 1958; Sheldon, 1968).

To reconcile these conflicting observations, several authors have proposed that the organism has an optimum level for novel stimulation, so that "the type of response sequence exhibited depends upon the degree of stimulus novelty [Welker, 1961, p. 218]." The concept of *degree of novelty* is also referred to as *level of incongruity* (Hunt, 1965) or of *complexity* (Dember, 1965; Walker, 1964), *rate of information* (Glanzer, 1958), and *arousal potential* (Berlyne, 1966), but the authors agree in the empiric prediction that novelty-seeking responses will occur under suboptimal levels of novelty, while supraoptimal amounts or degrees of novel stimulation evoke withdrawal.

Despite the theoretical importance of the optimal-level concept it has never been subjected to direct test, in part because of the requirement for methods of manipulating stimulus novelty. The main experiment reported here was designed to meet this requirement and to provide a direct test of the hypothesis that the direction of response will change with changes in the level of novel stimulation.

A second experiment which tested the generality of the results of the first experiment is also reported.

Experiment 1 and Replication

Method

Design. The level of stimulus novelty was defined in terms of the proportion of the stimulation available in a given situation which differed from the animal's prior experience. To obtain a high level of novelty, an animal was placed in a strange environment differing in many tactile, visual, and olfactory properties from the home cage. Under this condition, the optimal-level hypothesis predicted that the animal would show avoidance. This was tested by offering the subject the choice of entering a goal box containing a familiar-stimulus object, or one containing a comparable novel object. By selecting the familiar-stimulus box the animal could demonstrate avoidance of the novel stimulation presented by the environment and the novel-stimulus box.

The level of novelty was then reduced by repeated daily trials under the same conditions; the

[1] This research was funded in part by United States Public Health Service Predoctoral Fellowship 10,907 and in part by grants from the National Science Foundation to Richard D. Walk. Acknowledgement is made to Richard Walk, Lila Ghent, and Jacqueline Goodnow for their invaluable help.

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familiar stimulus remained the same, but the novel stimulus was changed daily to maintain its novelty. The hypothesis predicted that when the level of novelty declined below optimum, the animal would change to selecting the novel-stimulus box, which then represented a small source of novel stimulation in a largely familiar environment.

At the end of these trials, the level of novelty was again manipulated by exposing half the subjects to a different novel environment immediately before testing as usual. The prediction was that those animals who had experienced this increment of novel stimulation would tend to revert to selecting familiar stimuli in the subsequent test.

Subjects. The *S*s were 36 naive hooded rats about 4 mo. old, housed in same-sex groups of 6 and fed ad lib.

Familiarization. The object to be used as familiar was placed in the animal's home cage 14 days before testing. Half of the subjects received a glazed ceramic figure and the others received a gilt metal locket. These objects remained in the cages except when in use for each trial. Pretests with 36 naive animals showed no preference for either object.

Apparatus. The test took place on the raised Y runway shown in Figure 1. The runway was about 2 ft. long × 4 in. wide, with no start box. At the goal end was a platform in front of a wall in which were two raised doorways facing each other at 110°. Behind the doorways were two open-top goal boxes about 12 in. long × 7 in. wide. In each box a stimulus object was hung from a rod across the top and about 3 in. inside the door so as to be visible from the runway. Pretests with 48 naive animals showed no preference for either box when empty.

TABLE 1

ORDER OF PRESENTATION OF NOVEL STIMULUS OBJECTS USED IN EXPERIMENT 1 AND ITS REPLICATION

Trial	Familiar stimulus	Novel stimulus	
		Experiment 1	Replication
1	A: Ceramic figure	B: Metal locket	B
2	" " "	C: Scrub cloth	F
3	" " "	D: Plastic block	E
4	" " "	E: Garden label	D
5	" " "	F: Mousetrap	C
6	" " "	B: Metal locket	B
7	" " "	C: Scrub cloth	F
8	" " "	D: Plastic block	E
9	" " "	E: Garden label	D
10	" " "	F: Mousetrap	C
11	" " "	B: Metal locket, on floor	B on floor
12	" " "	G: Spoons and other items	H
13	" " "	H: Postcard and other items	I
14	" " "	I: Fish and other items	G

Note.—Shown for a subject which had Object A as familiar stimulus. For subjects having Object B as familiar stimulus, A was used in place of B as novel stimulus.

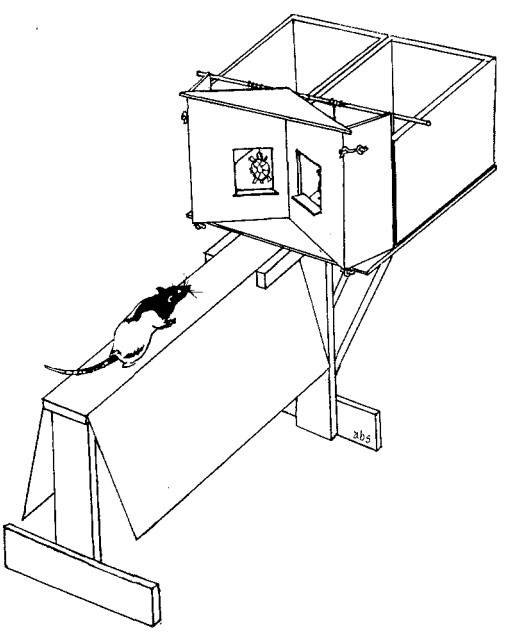

FIG. 1. The raised Y runway used in Experiment 1. (The familiar and novel stimuli were suspended from rods across the tops of the boxes. The apparatus was painted bright silver, evenly lighted from above, and surrounded by curtains within an acoustic-tiled walled cubicle.)

Test procedure. The familiar and novel stimuli were suspended in the goal boxes. An animal was then placed on the start end of the runway and timed until it entered either box with all four feet, when it was removed. Each *S* had one trial per day. Each *S*'s familiar stimulus remained the same for all trials, but the novel stimulus changed daily. The objects used and their order are shown in Table 1. All stimulus objects and arrays were pretested on naive animals (a total of 264 trials) and no preferences were found in any of the pairs presented in the experiment.

The familiar stimulus was changed from right to left between subjects on Trial 1. On succeeding days, half of the *S*s received the familiar stimulus in order LRRLLRLRRLLRLR and half in order RLRRLLRLRRLLRL which caused the stimulus to change sides for at least half of the *S*s on each trial and appear an equal number of times to right and left. The order of *S*s tested within cage groups was reversed daily.

To control the possibility of influence from other *S*s' odor traces (Whittier & McReynolds, 1965) the runway and boxes were washed with detergent between *S*s, the clean stimuli were washed

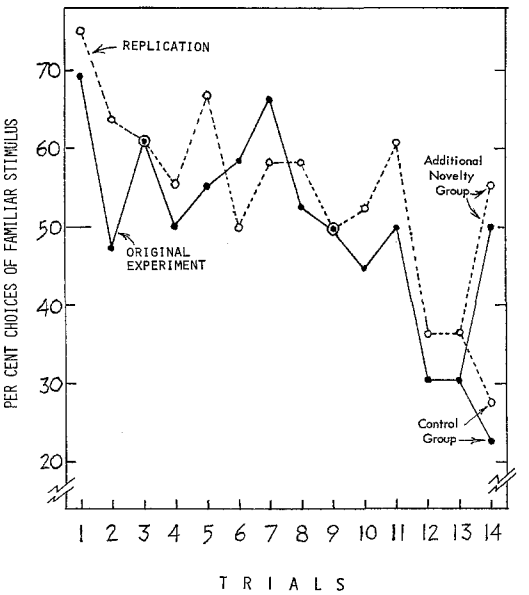

FIG. 2. The effect of declining environmental novelty on selection of familiar vs. novel stimuli in Experiment 1 and replication, shown as the percentage of subjects choosing the familiar stimulus on daily trials. (On Trial 14, half of the *Ss* received additional exposure to novel stimuli before testing, while the controls were tested as usual. $n = 36$ in both Experiment 1 and replication.)

between cage groups, and the entire apparatus was spray painted daily between sex groups. Possible trace odors from handling and airflow were also controlled.

Records. In addition to the main response measure of time of entry to a box, record was also kept of sequence of doorways inspected, partial entries, defecation, and "freezing." Animals failing to enter a box within 10 min. were to have been discarded, but none failed.

Additional novelty treatment on last trial. On Trial 14, half of the *Ss* in each cage were tested as usual, while the others were given 1-hr. exposure to a novel environment immediately before testing. This novel environment consisted of a primate cage filled with assorted novel objects, odors, a hamster, and six strange same-sex rats. After 1-hr. exposure *Ss* were given the regular test at once.

Stimulus subgroups. For 24 *Ss*, the familiar object was used as it came from the home cage and was thus both visually and olfactorily familiar. For 12 *Ss* the familiar object was represented by a clean duplicate and was thus only visually familiar.

Replication

Immediately after completing Experiment 1, the entire test was replicated with 36 naive animals from the same population, averaging 15 days older. This replication was identical in all respects with the first experiment except for a change in the order of presentation of novel objects as shown in Table 1.

Results

The results of the original experiment and the replication showed the same form and features, as seen in Figure 2. On the first trial in each test a significant majority of *Ss* selected the box containing the familiar stimulus ($\chi^2 = 5.44$ for Experiment 1 and 9.00 for replication, $df = 1$, $p < .025$ and .05, respectively). The preference for the familiar declined over trials until by Trial 12 a significant preference for the novel stimulus was seen ($\chi^2 = 5.44$ and 2.77, $df = 1$, $p < .025$ and .10). The combined χ^2 value for Trial 1 was 14.22 ($df = 1$, $p < .0005$) and for Trial 12 was 8.00 ($df = 1, p < .005$).

Preference for the novel stimulus remained stable through Trial 13. On Trial 14, half of the animals were exposed to a different novel environment immediately before testing, and these subjects showed a tendency to revert to selecting the familiar stimulus. The combined χ^2 value (corrected) for the difference between the pretreatment and control groups was 4.73 ($df = 1, p < .05$).

The progression from preference for familiar to preference for novel stimuli showed an interruption on Trial 11 which was thought to be an artifact arising from the absence, on this trial only, of the overhead rod in the novel-stimulus box (see Table 1). During the preceding 10 trials many animals developed stereotyped box-entering behavior in which they played with or jumped on this rod. On Trial 11 this behavior was not possible in the novel-object box. This explanation was tested in a subsequent similar experiment where both rods were left in place, and no such interruption of the trend appeared (Sheldon, 1968).

The mean cumulative exposure time to the apparatus through Trial 13 was approximately 8 min. Analysis of other records such as latencies, sequence of boxes inspected, defecation, etc. failed to yield any correlation with preference for the

familiar or novel stimulus, beyond a general trend to shorter latency. No sex differences in choice behavior were found.

Effect of visual and olfactory cues to familiarity. Figure 3 separates the results for the two subgroups which received different familiar-stimulus conditions. The same general trend appeared in both subgroups, but there was a suggestion that the combination of visual and olfactory cues to familiarity resulted in a stronger and more sustained initial preference for the familiar stimulus. The visual-cues-only group also indicated a weaker effect of the additional novelty treatment on the last trial, but the small number of *S*s (12) precluded interpretation.

These results will be discussed together with those of Experiment 2.

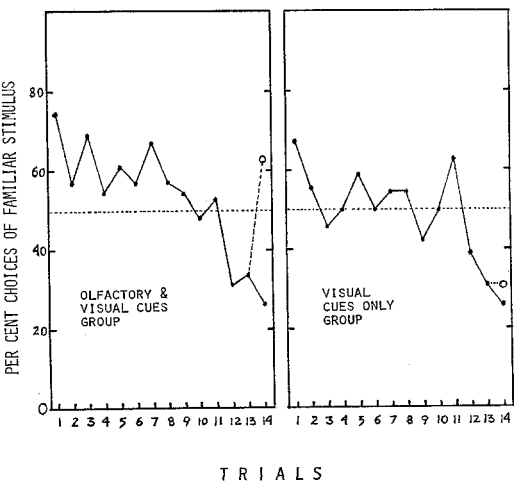

FIG. 3. The percentage of *S*s choosing the familiar stimulus in subgroups with different cues to familiarity in Experiment 1 and replication combined. ($n = 48$ for the subgroup with both visual and olfactory cues to familiarity, and $n = 24$ for the visual-cues-only subgroup. On Trial 14, open circles represent scores of *S*s given additional novelty before testing and closed circles represent control *S*s tested as usual.)

EXPERIMENT 2

Experiment 1 showed that animals on first exposure to a strange environment tended to prefer familiar stimulation. This initial response was critical for the hypothesis under test and has not previously been reported. Hence, it was desirable to determine whether it would occur under different experimental conditions.

To test for generality, eight one-trial tests were conducted with naive animals, using several different types of unfamiliar environments, stimulus modalities, familiarization, and response measures, but the same basic design. These tests are fully described in Sheldon (1968); a brief summary is presented here.

Method

In all tests, the hypothesis was that the animal exposed to a novel environment will approach a source of familiar stimulation in preference to a similar novel one.

Design features common to all eight tests. The design of all tests was that of the first trial of Experiment 1. Subjects were naive hooded rats, who had been familiarized with one stimulus before testing. In each test, *S* was placed in a strange environment where it had the choice of entering a compartment containing familiar stimulation or a compartment offering similar novel stimulation. Response measure was time of entry into a compartment with all four feet within 10 min.

Each *S* was tested once. The familiar and novel stimuli were equidistant from start. Each stimulus served as familiar to half of the *S*s and novel to the others, except in Tests 7 and 8 which used naturally familiar stimuli. Other controls, pretesting, etc. were as in Experiment 1.

Summary of the eight test conditions. These are presented graphically in Figure 4.

Test 1. Subjects: 178 adults rats. Unfamiliar environment: A rimless open field. Familiar and novel stimuli: Wood and metal containers approximately 7 × 10 × 7 in. placed on the table for testing. Familiarization: Approximately 40-min. confinement in one container before test, no food or water. Response measure: Climbing into a container.

Test 2. Subjects: 21 7-wk.-old rats and 2 adults. Unfamiliar environment: A covered T runway. Familiar and novel stimuli: Two plastic toys. Familiarization: Toy placed in maternity cage for 4–6 wk. Response measure: Crossing sill into goal box.

Test 3. Subjects: 36 adult rats. Unfamiliar environment: A covered T runway. Familiar and novel stimuli: A ceramic and a metal object. Familiarization: Object in home cage for 2 wk. Response measure: Crossing sill into goal box.

Test 4. Subjects: 43 adult rats. Unfamiliar environment: A raised runway, T type. Familiar and novel stimuli: Ceramic and metal objects. Familiarization: Object in home cage for 2 wk. Response measure: Climbing down onto one side of goal tray.

Test 5. Subjects: 18 7-wk.-old rats. Un-

familiar environment: A covered T runway. Familiar and novel stimuli: Artificial odors. Familiarization: Odor diffuser in maternity cage for 5 wk. Response measure: Crossing sill into goal box.

Test 6. Subjects: 21 adult rats. Unfamiliar environment: An open field backed by a wall with doors. Familiar and novel stimuli: Artificial odors. Familiarization: Odor diffuser in home cage for 7 wk. Response measure. Crossing sill into compartment behind wall.

Test 7. Subjects: 27 adult male rats. Unfamiliar environment: An open field backed by a wall with doors. Familiar and novel stimuli: A blend of familiar artificial and cage odor vs. a novel artificial odor. Familiarization: Odor diffuser in home cage for 7 wk. Response measure: Crossing sill into compartment behind wall.

Test 8. Subjects: 18 adult female rats. Unfamiliar environment: An open field backed by a wall with doors. Familiar and novel stimuli: A cagemate rat vs. a female hamster, both caged. Familiarization: Coresidence for 3 mo. (with rat only). Response measure: Crossing sill into compartment behind wall.

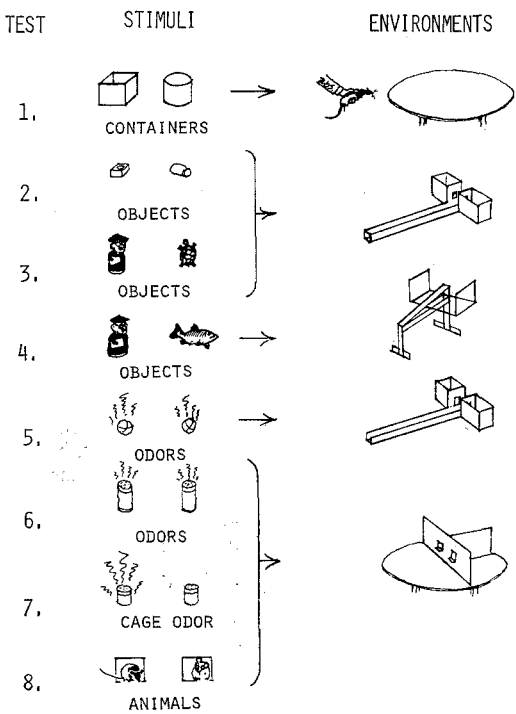

FIG. 4. The eight different test conditions used in Experiment 2, showing the types of novel and familiar stimuli and the strange environments in which they were presented. (The table used in Tests 1, 6, 7, and 8 was 4 ft. in diameter. The closed T runway used in Tests 2, 3, and 5 was about 5 ft. long. The raised runway of Test 4 was 2 ft. long, and the tray below it on which the stimuli were placed was wire mesh.)

TABLE 2

PREFERENCE FOR FAMILIAR STIMULUS IN EXPERIMENT 2

Test	n	n responding	Percentage of n responding which chose familiar stimulus	χ^2 (corrected)	p^b
1	178	129	62	8.14	.0005
2	23	20	75	4.05	.05
3	36	34	70	4.97	.05
4	43	43	58	0.84	*ns*
Total 2, 3, and 4[a]	102	97	66	9.89	0.05
5	18	17	82	5.88	.025
6	21	21	62	0.76	*ns*
7	27	27	89	14.81	.005
8	18	18	72	2.72	.10
Total 5, 6, 7, and 8[a]	84	83	77	24.39	.0005

[a] A few young animals were later used in other tests so all eight tests are not summed.

[b] $df = 1$.

Results

The results of the eight tests are shown in Table 2. In each test a majority of *S*s preferred the familiar stimulus, and this trend was significant in six of the eight tests.

DISCUSSION

The results of both experiments conformed to the predictions derived from the optimal-level hypothesis of novelty response. In terms of this concept, exposure to a strange environment functioned as a supraoptimal level of novel stimulation, from which the subjects withdrew by electing to enter a compartment offering familiar stimulation. The response of selecting familiar stimulation in a strange environment was observed under nine different types of experimental conditions.

Conversely, when the subjects of Experiment 1 were allowed to become familiar with the environment their response changed to selecting novel stimuli, which represented the approach behavior pre-

dicted at suboptimal levels of novelty. The change from novelty avoidance to novelty approach took place after an average cumulative exposure to the environment of about 8 min., which is within the familiarization period used in typical laboratory demonstrations of novelty approach (e.g., Dember, 1956). The present findings thus serve to relate the data on both positive and negative responses to novelty to the overall level of novel stimulation within a single experimental situation.

Also congruent with the optimal-level concept were the results of the additional-novelty pretreatment on the last trial of Experiment 1. On this trial, exposure to another novel environment represented a rise in the level of novelty, and the pretreated group showed the predicted tendency to revert to selecting familiar stimulation.

Many authors have pointed out the vulnerability of novelty response measures to influence from irrelevant variables (Sheldon, 1968). The interpretation of the responses obtained in the present design as functions of the novelty conditions is supported by the procedures used to control the known sources of contamination. For example, the effects of irrelevant stimulus properties were cancelled out by counterbalancing and controlled by pretesting. The effect of a specific strange environment or specific stimulus modalities was checked by testing different environments and types of stimuli. The possibility that the preference for the familiar stimulus might be attributable to secondary reinforcement was avoided by retaining the stimuli in the home cages during the period in which the subjects of Experiment 1 ceased to prefer them, and by testing the effect of a familiarization period without primary reward (Experiment 2, Test 1). Hence, it appears difficult to interpret the observed behavior as a function of stimulus variables other than the novelty conditions.

However, the results do incorporate an effect of species difference because the laboratory rat is known to display a very high degree of tolerance for novelty (Barnett, 1958; Richter, 1954). It is therefore likely that the specific conditions of stimulus novelty which functioned as supra- and suboptima for the tame strain of animals used in this study would require quantitative modification to elicit a similar range of response in feral strains and species.

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(Received May 7, 1968)