

CHOICE BY RATS FOR ENRICHED VERSUS STANDARD HOME CAGES: PLASTIC PIPES, WOOD PLATFORMS, WOOD CHIPS, AND PAPER TOWELS AS ENRICHMENT ITEMS

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The purpose of the present study was to determine whether simple additions to the home cages of rats made those cages preferable to standard housing arrangements. Results indicated that most rats preferred cages with wood platforms, wood chips, and paper towels to otherwise identical cages without these items. Wood chips were not, however, practical with the cages used in the present study. Plastic pipes caused no problems but were not preferred by most animals. Both wood platforms and paper towels created no problems and appeared to be useful as enrichment items. The latter were preferred to the former in a direct comparison.

Key words: nonhuman research, animal welfare, housing conditions, preference, rats

In recent years, the appropriate care of nonhuman research subjects has become a topic of major concern to psychologists (e.g., Feeney, 1987; Himeline, 1986; Miller, 1985; Segal, 1982). There appears to be general agreement that nonhumans deserve at minimum to be housed under conditions that minimize discomfort and ensure health, and standards for such housing have been promulgated by the American Psychological Association (1985) and the National Institutes of Health (1985).

These standards understandably permit housing conditions that do not closely resemble the natural environment. For example, bare wire cages, even if they are large and clean and provide ready access to food and water, are obviously unlike the usual habitat of rats. Whether this is significant is moot. Some authors have, however, suggested that the treatment of laboratory animals can be improved by enriching the environment in various ways (Champoux, Hempel, & Reinhardt, 1987; Novak & Suomi, 1988). One way in which environmental enrichment can improve housing conditions is by making them more preferable to the animals. The purpose of the pres-

ent study was to evaluate whether rats preferred cages enriched by the addition of plastic pipes, wood platforms, wood chips, and paper towels to otherwise identical wire-mesh cages similar to those used in many laboratories. These items were chosen because they are inexpensive, easily presented, and not obviously harmful. Moreover, a possible mechanism of reinforcement was apparent for each: The towels and the wood chips permitted nest building, the plastic tubes provided hiding places, and the wood platforms avoided contact with the wire floor and permitted chewing.

To assess preference, rats were given concurrent access to each of two sides of their home cage. One side was enriched, the other was not. Five times per day over a 10-day period, the side occupied by each rat was determined. These procedures are similar to those commonly used by behavioral psychologists to measure the relative reinforcing efficacy of alternative environmental arrangements, such as schedules of reinforcement (e.g., de Villiers, 1977).

In the final manipulation of the study, subjects were given a choice between two sides of a cage, one containing paper towels and the other containing a wood platform. The cage side containing each of these items was preferred in the first part of the study, and each of them posed no practical problems. Thus it was of some interest to see which item was preferred when paper towels and wood platforms were offered together.

The reported data were collected as part of the PhD dissertation of A. Lynn Bradshaw. The assistance of Yvonne Bradshaw in collecting data is gratefully acknowledged. Address correspondence and reprint requests to A. Lynn Bradshaw, Department of Psychology, Western Michigan University, Kalamazoo, Michigan 49008.

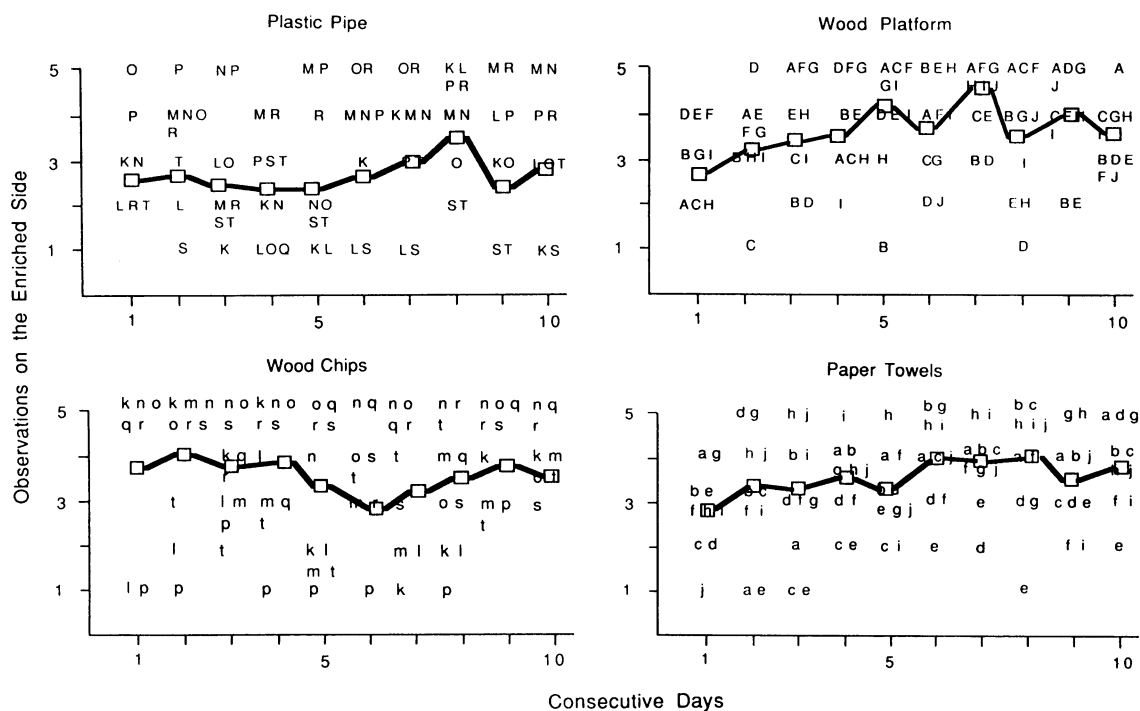


Fig. 1. Number of observations during which rats occupied the side of a home cage that contained the listed enrichment item when the other side was identical but did not contain that item. Each letter represents data for an individual rat. Group means are indicated by open squares connected by lines. Each of 10 rats exposed to a given item was observed five times per day over 10 consecutive days.

METHOD

Subjects

Fifty male Sprague-Dawley rats served as subjects. Subjects were between 0.5 and 1 year of age at the beginning of the study. All of them had been used briefly in behavioral studies. Housing conditions and the maintenance of subjects are described in the procedures section.

Apparatus

Ten stainless steel cages (Unifab) were used. Each cage was 48 cm long, 30 cm deep, and 20 cm high. The back and side walls were solid. The front wall and floor consisted of square wire mesh with individual wires separated by 1.3 cm. A fiberboard partition 18 cm high divided the cage into two equal sides, each 24 cm long and 30 cm deep. To allow subjects to pass from one side to the other, a square hole (7 cm by 7 cm) was cut from the top center of the partition. Two water bottles were mounted on the front of the cage and were located 10 cm from each side wall with

spouts 4 cm above the cage floor. A 13 cm high and 20 cm long wire mesh feeder constantly filled with Purina® Rodent Chow #5001 was centered horizontally on the front of the cage. Placement of the water bottles and feeder allowed equal access to water and food from either side of the partition. Individual cages were located in a climate-controlled colony area maintained at approximately 74 °F. During the course of the study, the colony area was constantly illuminated.

Four enrichment items were used: single-ply brown paper towels (33 by 26 cm), red cedar wood chips (American Wood Fibers), 18-cm lengths of white plastic (polyvinylchloride) pipe (7.6 cm in diameter), and squares of 0.6-cm thick plywood (20 cm by 20 cm). To prevent wood chips from falling through the wire-mesh cage floor, hardware cloth was attached by metal clips to the outside of the cage bottoms.

Procedure

Rats were given a choice between two sides of the wire-mesh cage. During the initial in-

Table 1
Percentage of observations on the enriched side for individual subjects.

Enrichment item	Subject									
	K	L	M	N	O	P	Q	R	S	T
Plastic pipe	46	46	84	66	68	84	2	80	28	42
Wood platform	A	B	C	D	E	F	G	H	I	J
	86	60	68	68	72	88	86	70	72	46
Wood chips	k	l	m	n	o	p	q	r	s	t
	64	32	64	98	92	24	90	94	84	68
Paper towels	a	b	c	d	e	f	g	h	i	j
	72	78	60	64	42	64	82	90	74	76

vestigation, one side of the cage provided access to food and water but was otherwise barren. This side approximated typical housing conditions. The other side was identical in all respects with the exception of one item intended to enrich the environment. For randomly selected groups of 10 rats, these items consisted of wood chips, paper towels, wood platforms, and lengths of plastic pipe. Each enrichment item was placed on the left side of five cages and on the right side of the five remaining cages. Wood chips were smoothed to a depth of about 2.5 cm, paper towels were placed at the back of the cage in a group of 15, wood platforms were laid flat on the cage floor, and lengths of plastic pipe were placed horizontally in the approximate center of the appropriate side. Each enrichment item was placed in cages one day before observations were begun.

Data were collected by direct observation. Observations were made five times per day, at 9:00 a.m., 12:00 noon, 3:00 p.m., 6:00 p.m., and 9:00 p.m. At these times, a single observer recorded which side of the cage each rat occupied (i.e., standard or enriched). Observations were made over the course of 10 consecutive days. During this time, paper towels were replaced if dampened from the water spouts. Despite the hardware cloth cage bottoms, wood chips frequently fell from the cage. When this occurred, the chips were replaced to a depth of 2.5 cm.

In the final manipulation, a group of 10 rats was given a choice between wood platforms and paper towels. Rats chose both of these items relative to the unenriched side, and both were simple to arrange. Choice between these items was arranged and measured as described above, with the exception that paper towels

were placed on one side of the cage (the left for 5 animals, the right for the remaining 5) and the wood platforms were placed on the other side.

For the study as a whole, a second observer independently recorded data during 18% (460 of 2,500) of observations. Independent observations were arranged for each of the five groups of subjects. The minimum number of independent observations made for a group of rats was 70 of 500; the maximum was 110 of 500. In every case, the data recorded by the two observers were identical (i.e., interobserver agreement was 100%).

RESULTS

Figure 1 shows the results of giving rats a choice between a standard housing condition and a condition enriched by the addition of plastic pipes, wood platforms, wood chips, and paper towels. Data for individual rats and mean group data are shown across days. It is apparent from these data that, regardless of the specific enrichment item, rats generally preferred the enriched side of the cage to the alternative side. For all animals and observations, the side of the cage with plastic pipe was occupied on 273 of 500 observations (55%), the side with the wood platform was occupied on 358 of 500 observations (72%), the side with wood chips was occupied on 355 of 500 observations (71%), and the side with paper towels was occupied on 351 of 500 observations (70%). There was, however, considerable variation in the behavior of individual subjects. Table 1 shows, for each subject, the percentage of observations on the enriched side with each enrichment item. Some subjects occupied the barren side during most observations. This oc-

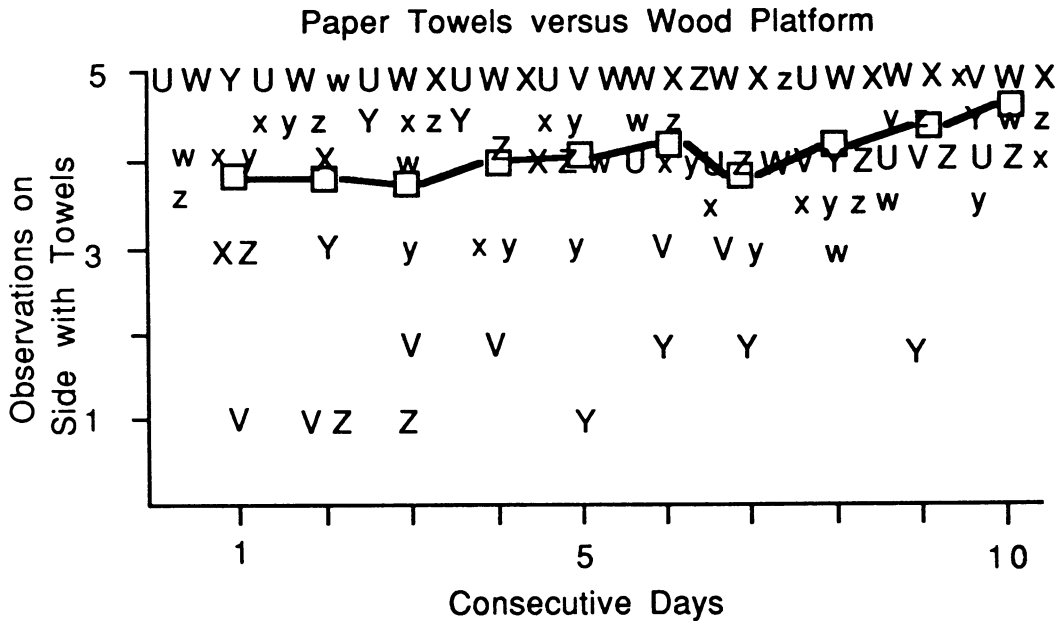


Fig. 2. Number of observations during which rats occupied the side of a home cage that contained paper towels when the other side contained a wood platform. Details are as in Figure 1.

curred with 5 subjects when plastic pipes were present, 1 subject when wood platforms were used, 2 subjects when the wood chips were present, and 1 subject when paper towels were available. When the behavior of individual subjects is considered, the plastic pipe was not clearly preferred. This was not the case with the other enrichment items, which were preferred by the majority of subjects.

The data in Figure 1 were analyzed statistically by means of chi-square tests, in which the actual number of times each rat occupied the enriched side was compared with the number expected by chance (i.e., 25 of 50 observations). These analyses indicated that the preference for the enriched side was significant for each of the enrichment items ($df = 9, p < .01$).

Figure 2 shows the results when subjects were given a choice between paper towels and wood platforms. A strong and statistically significant (chi-square, $df = 9, p < .01$) general preference for paper towels was evident. Overall, the side with paper towels was occupied on 351 of 500 observations (70%). Each rat occupied the side with paper towels during most observations. The percentage of observations on the side with paper towels for individual rats was 92 (Subject U), 60 (V), 100

(W), 92 (X), 70 (Y), 68 (Z), 80 (w), 86 (x), 76 (y), and 94 (z).

DISCUSSION

The relationship between human experimenter and nonhuman subject is a complex and asymmetrical one that concerns many people. There is general agreement among researchers that subjects deserve appropriate treatment. But what, beyond compliance with federal and local guidelines, constitutes appropriate treatment for a given subject? As Hineline (1986) noted,

Whatever the bases for undertaking research with animals—and for many purposes there are no adequate alternatives (e.g., see Gallup & Suarez, 1985)—there is agreement that housing conditions and experimental procedures should be humanely and responsibly arranged. Yet in attempting to do this, one discovers that identifying “best practice” often is not a straightforward matter. (p. 124)

The purpose of the present study was to determine whether simple additions to the home cages of rats made those cages more preferred, and in that sense “better,” than standard housing arrangements. Results indicated that most rats preferred cages with wood platforms, wood

chips, and paper towels to otherwise identical cages without these items. Wood chips were not, however, practical with the cages used in the present study, because they fell through the cage floor unless hardware cloth was attached to it. When this was done, cage cleaning was difficult. Thus, wood chips did not appear to be useful as enrichment items. The same held for plastic pipes, which caused no special problems but were not preferred by the majority of individual animals.

Neither paper towels nor wood platforms caused serious problems, and cages containing each of these items were preferred to standard cages. Thus, it appears that researchers interested in providing preferred enrichment items for rats could make use of either of these items. Of course, before so doing, investigators should secure approval from appropriate regulatory agencies. Adding enrichment items to home cages is not standard practice and may be inconsistent with the recommended practices of some regulatory bodies.

Although the procedures employed in the present study were adequate to provide a gross index of preference, each subject was observed only 50 times across the course of a 10-day period. This may have increased the likelihood of sampling error. Appreciable individual differences were evident in the data, and it possible that results would have been more consistent across subjects had continuous observation been arranged. But is it also possible, and in fact likely given the magnitude of the across-subjects differences in behavior under some conditions, that subjects differed in their actual preference. If so, the variables accounting for the differences are unknown. Even under conditions in which across-subjects variability was relatively small (as when paper towels were compared to wood platforms), preference typically was not exclusive. This suggests that there were multiple sources of reinforcement in the environment, in addition to those associated with enrichment items. It is possible that the relative desirability of a particular enrichment item depended on the activity in which a subject was engaging at a particular time, and that subjects differed with respect to the time allocated to particular activities. Further, and finer grained, research is required to evaluate this possible explanation of individual differences.

A point of interest in the present data con-

cerns the strong preference exhibited for paper towels over wood platforms. When these items were used singly as enrichment items, comparable preference was observed. Given this, and assuming that transitivity held with respect to preference, subjects should have been essentially indifferent when offered a choice between paper towels and wood platforms, but they were not. This indicates that, under the conditions of the present study, choice for one alternative relative to the other could not be predicted accurately on the basis of choice for each item relative to a third alternative. Put differently, intransitivity of preference was evident. The theoretical implications of intransitivity for theories of choice, and the conditions under which it characteristically occurs, have been considered elsewhere (e.g., Fantino & Navarick, 1974; Navarick & Fantino, 1974).

The present data indicate that rats have a pronounced preference for paper towels as enrichment items. Does this imply that, if regulatory agencies approve, researchers who work with rats should add paper towels to their home cages? Not necessarily. Paper towels provided an opportunity for a significant species-typical behavior, nest building, and rats in the present study immediately constructed nests that they occupied during most observations. The availability of towels did them no apparent harm and increased their behavioral options. Nonetheless, as Novak and Suomi (1988) discussed, there are many variables that must be considered in evaluating how a laboratory environment affects a given subject. They proposed four criteria for establishing the "psychological well-being" of nonhuman primates, which involved evaluating a subject's (a) physical health, (b) behavioral repertoire, (c) reaction to stress, and (d) competence in meeting environmental demands. These same dimensions are relevant to the well-being of rodents and merit attention. We propose only that subjects' preference is another important dimension that should be considered in evaluating alternative living arrangements.

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