Evaluation of the Long-Term Effectiveness of Two Environmental Enrichment Objects for Singly Caged Rhesus Macaques

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Provision will soon become mandatory to enrich the environment of singly caged nonhuman primates in the research laboratory environment. Specific objects such as puzzle feeders have been recommended [1]. Bloom's study raises the important questions of how much time do environmental enrichment objects actually distract an animal and are different objects equally effective. A variety of other environmental enrichment objects have been described, and their initially stimulating effects observed [2]. The question of whether an object retains its stimulation effect over time has been addressed in only one case; after 11 months of exposure fewer than 10% of 148 rhesus macaques and none of 33 cynomolgus macaques continued to be distracted by nylon balls [3].

A sound environmental enrichment policy will have to take these earlier studies into consideration to provide reasonable solutions. What would be the use of offering singly caged primates objects that initially provide some distraction due to their novelty effect, but after several months of exposure are used by only a few animals during a negligible proportion of the time? The present study evaluates the proportion of time individually caged rhesus macaques spent using two different objects (suspended perch and loose branch) to which they were exposed for an extended time.

Figure 1. A suspended perch is a particularly valuable environmental enrichment object for macaques living in

dark lower-row cages.

METHODS

The subjects were 25 healthy male rhesus monkeys, 8-14 years of age. They were caged singly in two identical rooms, each of which accommodated 16 cages (85 cm wide, 85 cm deep, 85 cm high). The cages were not equipped with squeeze apparatus, but were provided with a loose box-elder branch segment [4] and a 120-cm-long polyvinyl chloride (PVQ) pipe that was suspended diagonally about 40 cm above the floor [5] (See Fig. 1.). The animals had been exposed to both objects for one year. The branch segments were regularly replaced due to wear; the last replacement took place one month before this study. In each room, cages were arranged in two lower rows and two upper rows facing each other. Animals living in lower-row cages received markedly less light-especially in the rear half of the cage-than animals living in upper-row cages (See Fig. 1.). When sitting on the floor of the cage monkeys in the lower rows were 30 cm above the ground; monkeys in the upper rows were 140 cm above the ground. The animals had been transferred to the two rooms 3 months prior to this study and randomly assigned to lower-row or upper-row cages.

The monkeys were fed commercial dry food at 8:15 and supplemented with fruit at 15:15. Drop pans were cleaned at 8:00 and 15:00. The animals did not have to be removed for the cages to be cleaned. They were well acquainted with the observer, who checked their general health condition on a daily basis. Each monkey was observed for a total of 2 hours on two different occasions from 12:00 to 13:00 when no distractions were caused by human activities. The interval between the first and the second observation was 1 week. During each session two neighboring males were observed simultaneously, and the manner and time spent in physical contact with the two environmental enrichment objects were recorded. The statistical data analysis was done using the Mann-Whitney test [6], with the level of significance set at $p < 0.05$.

RESULTS

The singly caged monkeys spent on average 28% (2030/7200 sec) of the total observation time with the PVC pipes but only 3% (238/7200 sec) with the branch segments; the difference was significant (See Table 1.) Individuals were actively distracted by the PVC pipes up to 100% of the time, by the branch segments up to 21% of the time. Ninety-six percent (24/25) of the animals were seen using the pipes; 52% (13/25) were seen using the branch segments. Examination of the branch segments revealed traces of wear in 96% (24/25) of cases.

Perching accounted for 94% (1908/2030 sec) of the time animals spent with the pipes. While perching, the monkeys sat in front of the cage for 95% (1816/1908 sec) of the time, in the middle or rear of the cage for 5% (92/1908 sec) of the time. Gnawing accounted for 97% (230/238 sec), manipulating for 3% (8/238 sec) of the time spent with the branch segments. While using the segments, the monkeys were sitting on the cage floor for 88% (210/238 sec) of the time, but on the PVC pipes for only 12% (28/238 sec) of the time.

The proportion of time spent with the pipes was three times greater for animals living in lower-row cages than for animals living in upper-row cages; the difference was significant (See Table 1.). This was confirmed, both during the first observation (Mean, lower-row = 45.2% +/- 27.9 vs. Mean, upper-row = 12.0% +/- 15.7) and during the second observation (Mean, lower-row = 41.5% +/- 26.3 vs. Mean, upper- row = 19.8% +/- 27.1). The proportion of time spent with the branch segments showed no significant difference between upper-row and lower-row caged animals.

	PROPORTION OF PVC PIPE	TIME SPENT WITH BRANCH SEGMENT
Males living in upper-row cages		
Ulrich	20.1%	3.5%
Dali	0.8%	2.4%
Leo	100.0%	0.0%
Dusty	0.3%	0.0%
Canto	0.0%	0.0%
Rudi	1.3%	16.5%
Curtis	16.8%	0.0%
Clark	1.5%	0.0%
Yorkick	33.6%	2.5%
Franz	8.1%	20.6%
Bruce	13.8%	8.2%
Irving	3.7%	0.0%
Damion	1.7%	1.8%
Mars	26.2%	2.5%
Mean	16.3%	3.4%
SD	25.5	4.8
Males living in lower-row cages		
Klaus	42.6%	6.2%
Mathias	45.0%	0.0%
Ludwig	17.8%	1.7%
Johann	45.0%	3.4%
Jeff	50.8%	0.1%
George	1.9%	0.0%
Tom	75.1%	0.0%
Sheldron	38.5%	13.0%
Eeyore	22.6%	0.0%
Celery	93.9%	0.0%
Parsnip	44.2%	0.0%
Mean	48.4%	2.2%
SD	24.2	3.9

Table 1. Proportion of time spent by singly caged male rhesus monkeys with environmental enrichment objects during 2-hour observation.

DISCUSSION

The PVC pipes and the branch segments were effective environmental enrichment objects, and 96% of the 25 singly caged rhesus monkeys exhibited active interest in them after 1 year of exposure. However, the two objects differed in the proportion of time they distracted the animals. The monkeys spent substantially more time with the suspended pipes than with the loose branch segments.

Living in an upper-row or in a lower-row cage had an impact on the attractiveness of the PVC pipes but not on the attractiveness of the branch segments. While using the branch segments, the monkeys were generally sitting on the cage floor; close to the front of the cage. In the elevated position, the light exposure was increased, a fact that made the pipes of particular value for the lower-row caged animals. In the wild, macaques spend much time in trees as a safeguard against predators. In this author's opinion, being confined in a cage close to the ground may considerably decrease their feeling of security. If this author's assumption is correct, an elevated perch not only provides effective distraction but also enhances the well-being of laboratory macaques, especially of those living in lower-row cages.

Both a suspended perch and a loose branch segment provided enrichment in this study and are recommended as objects to enrich the environment of singly caged rhesus monkeys because of the following reasons: they stimulate the animals to perform species-typical behavior patterns, such as perching and gnawing; they receive the animals' attention even after

long-time exposure; and, they are inexpensive. A suspended perch, in this study, enriched the environment of singly caged rhesus monkeys - in particular those living in dark lower-row cages more effectively than a loose branch segment.

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