Preference for various surrogate surfaces among infant rhesus monkeys¹

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Two infant rhesus monkeys were tested in terms of contact time for preference among four surrogate mothers with different body surfaces. Durations of contact differed significantly among the surrogate surfaces, which ranked from greatest to least time in the following order: cotton sock, rayon and vinyl (equal), and sandpaper. The results indicate that infant monkeys have clear-cut preferences among surrogate surfaces.

The surrogate mother has proved its usefulness many times as a research tool and as an economical and simple device for raising motherless infant monkeys (Harlow, 1958; Harlow & Suomi, in press). When the original studies of infant-surrogate attachment were conducted, common sense indicated that a textured cloth surface would provide more "contact comfort" than would either wire mesh, certainly, or a smooth cloth surface. The infants' specific preferences among a multitude of varying surfaces went untested in these early studies, since the investigators were usually more interested in studying the development of infant-surrogate attachment than in quantifying positive cloth surfaces. From the point of view of the post office, this was unfortunate, since Harlow subsequently received countless letters criticizing the choice of surrogate surface materials. These comments fell into two main categories: that wire is an aversive substance for infants, and that there is no reason to believe that infants would prefer one nonaversive surface over another.

The present study was conducted to determine if infants have any preference among different types of surrogate surfaces, and if so, to rank these surfaces according to preference. The surfaces used were selected on the basis of grossly varying textural qualities: cotton athletic socks (soft and textured), rayon (soft and smooth), vinyl cloth (hard and smooth), and rough-grade sandpaper (hard and rough).

SUBJECTS

Two female rhesus infants (*Macaca mulatta*), aged 19 and 21 days at the beginning of the study, were used.

APPARATUS

The infants were housed in standard

wire-mesh nursery cages, 15 x 15 x 20 in., with Plexiglas doors. The types of surrogates employed were newly designed "super-simplified surrogates" (Harlow & Suomi, in press). These were made from boards, 1½ x 4 x 10 in., with a scooped-out concave trough having a maximum depth of ¾ in. running the length. As shown in Fig. 1, this surrogate can rest at an inclination of less than 15 deg, from the base, though this angle can be varied. The surrogates were covered with a white Size 11 cotton athletic sock, blue rayon dress lining, green cotton-backed vinyl (both rayon and vinyl were sewn in tubular form and elasticized at both ends), and sandpaper (Garnet Paper Openkote, Grade 36-D), which was molded to the surrogate and taped on the underside. A 12-clock counter bank, accurate to 1/100 min, was used to record duration of contact with the surrogates.

PROCEDURE

About 23½ h prior to a test period, each infant was presented with two surrogates covered with different materials. Each possible combination of two of the four surfaces was presented randomly to each infant over a period of 6 days, and this series of six presentations of pairs was replicated twice for each infant. Following the 23½-h adaptation period to the surrogate pairs, each infant was tested for ½ h per day for duration of contact with each of the surrogates in her cage.

RESULTS

Mean durations of contact time with each surrogate surface were compared using the Duncan New Multiple-Range Test (Steele & Torrie, 1960). These results are presented in Table 1. All possible comparisons yielded significant preference differences at the 0.05 level or less, with the exception of the vinyl-rayon comparison, in which the difference was not significant.

On the basis of the Duncan Range Test, comparisons between specific pairs were made using a one-tailed t test for paired

Fig. 1. The "super-simplified surrogate," unclad.

comparisons (Table 2). Again, all differences were significant at the 0.05 level or less, with the exception of the rayon-vinyl pair. The cotton sock in both of the above comparisons was shown to be uniformly preferred over all other surfaces; rayon and vinyl were preferred about equally, and sandpaper was preferred least. The percentage of total contact time on each of the surfaces in each pair is presented in Fig. 2.

It is of interest to note that mean contact time with any surface was not constant across the pairs of surrogates. Total contact time between different sets of pairs was compared using the Duncan New Multiple-Range Test (Table 3), and significant differences were found in 4 of the 15 possible comparisons. All of these differences were between pairs in which the cotton cover was present vs those in which the cotton cover was absent. Although most differences were not significant, inspection of the means reveals a two-way trend. Among the sock-containing pairs, mean total contact time increases with decreasingly preferred covers, whereas among pairs that do not include a sock, total contact time decreases with the presence of decreasingly preferred covers.

DISCUSSION

The above results clearly establish that monkey infants do have preferences among various surrogate surfaces, even those that would be termed nonaversive by human

Table 1
Mean Contact Time in 30 Min Periods for Each of the Surrogate Surfaces, and Differences Between the Means as Compared by the New Duncan Multiple Range Test

Surface	Mean Contact Time	Comparison	Difference	p
Sock	14.27	Sock-sandpaper	12.60	<0.01
Rayon	5.93	Sock-vinyl	9.43	<0.01
Vinyl	4.84	Sock-rayon	8.34	<0.01
Sandpaper	1.67	Rayon-sandpaper	4.26	<0.01
		Rayon-vinyl	1.09	n.s.
		Vinyl-sandpaper	3.17	<0.05

Fig. 2. Per cent of total contact time on each surrogate surface, for each of the pairs presented.

Table 2
Comparisons of Mean Contact Time in Min for Each Pair of Surrogate Surfaces Presented

Pair	Mean Difference	t (1-tail, 5 df)	p
Cloth-rayon	8.22	2.22	<0.05
Cloth-vinyl	7.50	2.09	<0.05
Cloth-sandpaper	16.90	26.82	<0.0005
Rayon-vinyl	2.65	1.07	n.s.
Rayon-sandpaper	4.78	3.73	<0.01
Vinyl-sandpaper	2.66	3.37	<0.01

investigators. It is perhaps fortunate that the preferred surface was the cotton sock, since an investigator must serve two masters, his animals and his budget, and cotton socks are by far cheaper to purchase and launder than are the other types of surfaces tested.

On the whole, infants spent little time contacting sandpaper-covered surrogates, and what contact did exist was incidental or exploratory in nature. While they spent some time sitting or sleeping on all the other surfaces, they never displayed either of these behaviors on the sandpaper, and no sensible primate would. In view of the trend towards greater total contact time on the cloth surface when it was paired with the sandpaper surface, the hypothesis is advanced that since the aversive substance produced greater avoidance, it may have acquired characteristics similar to those of a fear stimulus. The substance giving greatest contact comfort also probably imparted more security to the infant (as was found by Harlow, 1958), and the infant therefore spent a greater total amount of time on this surface. This difference is also reflected in the minimum duration of contact time with cloth in the presence of the other three substances. When paired with rayon, the minimum contact time was 0 min, with vinyl, 4.88 min, and with sandpaper, 15.18 min.

This experiment also demonstrated the value of the "mini-experiment" in work other than operant research. This is a type of experiment in which few Ss are used, even though the experiment is in itself complete and need not be regarded merely as a pilot study.

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Table 3
Mean Total Contact Time 30 Min Periods for Each of the Pairs of Surrogate Surfaces and Differences Between Means as Compared by the New Duncan Multiple Range Test

Pair	Mean	Significant Differences	p
Cloth + sandpaper	20.02	Cloth + sandpaper - vinyl + sandpaper	<0.01
Cloth + vinyl	18.57	Cloth + sandpaper - rayon + sandpaper	<0.05
Cloth + rayon	14.41	Cloth + vinyl - vinyl + sandpaper	<0.05
Rayon + vinyl	12.79	Cloth + vinyl - rayon + sandpaper	<0.05
Rayon + sandpaper	8.59		
Vinyl + sandpaper	5.76		

NOTE

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Heart rate as a function of water deprivation and conditioning: Some additional controls¹

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days) failed to manifest this response. Thus, several potential sources of artifact in a prior study were eliminated.

Heart rate (HR) was recorded from 23.5- and 47.5-h water-deprived rats during 12 days of adjustment to the deprivation schedules and throughout subsequent conditioning. No HR effects of deprivation per se were noted, but a significant tachycardia developed during conditioning. A 47.5-h deprived group never given water in the apparatus throughout the entire deprivation period (approximately 60

In a previous report (Goldstein, Stern, & Rothenberg, 1966), evidence consistent with Malmö's (1959) activation hypothesis was presented in which the heart rate (HR) of water-deprived rats was observed to increase in the presence of stimuli associated with water. In that study, however, several potential sources of artifact existed; the present study was