

SNAKE AVOIDANCE AND TOOL USING BY
CAPUCHIN MONKEYS

by

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ABSTRACT

The present study was designed to determine the habituation rate of food taking latencies by Capuchin monkeys in the presence of a live snake, two snake-like stimuli, and two neutral stimuli. The results showed that habituation occurred as the food taking latencies decreased over days. Measures of locomotion, vocalization, scanning and withdrawal showed similar results. Further, the snake conditions yielded significantly longer food taking latencies than the neutral stimuli. During testing the significance of the technique was shown as tool using behavior was elicited by all subjects. This behavior was brought under experimental control since it frequently occurred under snake and snake-like conditions and almost never under the neutral stimuli.

INTRODUCTION

The bravest of men since Adam's time have found the lowly serpent a fearsome sign. The creature condemned to crawl on its belly turns all kinds of primates to puddles of jelly. And so the dreaded snake slithers and skulks, grabbing his meals in monkey-sized gulps.

Emotional behavior in man and animals has been the subject of fascinated observation and speculation for centuries. In The Expression of the Emotion in Man and Animals, Darwin (1872) made the first systematic attempt to look at similarities and differences of emotional behavior in man and animals and speculated on the evolutionary development of emotional displays.

Man as well as non-human primates often display exaggerated emotional behavior when confronted with snakes or even objects that resemble snakes. Manifestations of fear, fleeing, and excited vocalizations are frequent components of these intriguing displays.

The early experiments on snake avoidance in primates featured a uniform lack of experimental sophistication. Warwick (1832), for example, reported that a female orangutan displayed fear of a boa constrictor and a toy snake. Brown (1878a, 1878b) placed a coiled snake into a cage of Macaques and observed that they avoided it. Mitchell (1912) presented several primate species a snake. He reported that baboons, capuchins, chimpanzees, gibbons, guenons, howlers, mandrills, macaques, orangutans, spider monkeys and woolly monkeys displayed

avoidance of the snake; marmosets and lemurs were unresponsive to the snake. Evaluation of Mitchell's (1912) data is difficult as he observed the subjects in a social situation, i.e., different species were housed in the same cage.

Early observation of primates' reactions to encounters with snakes in the field showed the following results. Antonius (1939) reported that chimpanzees exhibited caution in the presence of large snakes and that, in the presence of small snakes, the chimpanzees showed some aggressive responses. Isemonger (1962) observed pythons attacking snakes. Hall (1963) noted that chacma baboons avoided a large mole snake. Lorenz (1971) reported that several primate species, including capuchin monkeys, displayed avoidance of snakes. However, Kortlandt and Kooij (1963) reported that capuchins ate snakes.

Most previous experimental studies have had apes and Old World Monkeys as subjects. While infant chimpanzees avoided all animate objects, adult chimpanzees avoided snakes and stimuli closely approximating snakes (Haslerud 1938, Hebb 1946, Yerkes and Yerkes 1936, Schiller 1952).

Experimenters using rhesus monkeys have shown the following results. Tinkelpaugh and Hartman (1932) found that rhesus monkey mothers restrained their young in the presence of a snake. Green (1965) noted that juvenile and adult feral rhesus monkeys had a longer food taking latency in the presence of a snake than in the presence of a gray painted wooden tray. Butler (1964) demonstrated that a rhesus monkey would learn to pull a chain to keep a cage illuminated in the presence of a snake. However, only one-half of the subjects kept the light

illuminated in the presence of a snake, while the other one-half did not keep the box illuminated in the presence of a snake. Bernstein and Mason (1962) used rhesus monkeys ranging in age from one month to 27 months and concluded that a snake stimulus elicited fewer emotional responses than a dog, a grasshopper, or a beetle. Wolin, Ordy and Dillman (1966) found no significant differences between feral, laboratory, and zoo-reared rhesus monkeys' avoidance of a garter snake. Singh (1966) showed that urban and forest dwelling rhesus monkeys avoided a stuffed cobra. While Joslin, Fletcher and Emlen (1964) reported that feral rhesus monkeys had longer food taking latencies in the presence of a bull snake than did laboratory-reared monkeys, the two groups' latencies did not differ significantly in the presence of neutral stimuli.

Rumbaugh (1968) reported some informal observations indicating that squirrel monkeys avoided snakes. Murray and King (1973) later demonstrated that feral and non-feral squirrel monkeys avoided snakes. Furthermore, the feral group had longer food taking latencies than laboratory-reared groups in the presence of real and rubber snakes. However, they reported that by the end of testing, there were no significant differences between the two groups.

The purpose of the present study was to measure food taking latencies by capuchin monkeys in the presence of a series of stimuli virtually identical to those used by Murray and King (1973) in their research with squirrel monkeys. These researchers showed that shape was a more important determiner of food taking latencies than snake coloration. This conclusion was based on the fact that a rubber snake

painted with snake-like colors yielded the same food taking latency as one painted gray, while both rubber snakes yielded significantly longer latencies than two sinuous rubber tubes painted the same as the two rubber snakes. One of the questions which the present study was designed to answer was whether a similar relationship could be obtained for capuchin monkeys. Interest was also directed at the relative rates at which the two species habituated to the snake.

Kauffeld (1969) reported that the common boa preys on monkeys in the wild. Parker (1963) states that the common boa range from Mexico to Central Argentina, an area including the habitat of the capuchin monkey. In addition, Curran and Kauffeld (1937) have stated that the common boa can grow to a length of 12 feet. Therefore, the common boa is most probably the natural predator of the capuchin monkey.

METHOD

Subjects

Seven feral capuchin monkeys (Cebus apella) were subjects. They had been captured when approximately 20 to 28 months of age and were housed in the laboratory for approximately 12 months prior to the start of the experiment.

Apparatus

The food taking latencies of the subjects were measured in the presence of each of the following stimuli:

1. A young boa constrictor (boa constrictor constrictor), about 23 cm long.
2. A coiled rubber snake painted to closely approximate the colors and markings of the boa constrictor.
3. A coiled rubber snake painted gray.
4. A coiled rubber tube painted gray.
5. A wooden block painted gray.

All subjects were tested in a modified Wisconsin General Test Apparatus (WGTA) described by Harlow and Bromer (1938). Each subject was tested separately in a stainless steel transport cage (33 cm wide, 38 cm long, and 36 cm high) placed behind an opaque screen, which was raised and lowered manually. A clear plexiglass box (12.70 cm wide,

15.78 cm long, and 7.50 cm high) containing one of the stimuli, was located on the stimulus tray behind a 2.54 cm diameter foodwell that contained a piece of brown seedless raisin. The subject's view of the experimenter was impeded by a one-way vision screen.

An electric timer operated by a foot pedal measured the latency between the raising of the forward opaque screen of the WGTA and the subject's retrieval of the raisin. During the interval between the raising of the forward opaque screen and the retrieval of the raisin, a series of duration counters were used to record the following behaviors: visual scanning (any eye or head movements where the subject looks at or toward a stimuli); withdrawal (any retreat from the front of the cage to the rear of the cage); locomotion (gross body movements and/or change in location of trunk made by the subject); and vocalization (any vocal sound made by the subject).

Experimental Design

This study used a within subjects design wherein all subjects were given repeated trials with all five stimuli presented in a counter-balanced order. Specifically, each subject was given 70 trials with each stimulus over 14 days of testing. The stimulus presentation order insured that each stimulus followed each other with approximately equal frequency. No stimulus was ever repeated on two successive trials. Each stimulus was presented five times each day for a total of 25 trials. Subjects were tested every other day seven days a week.

Procedure

A typical trial was effected by placing a raisin in the foodwell and a stimulus in the plastic box behind the foodwell on the tray and then pushing the tray up to the lowered opaque screen. Then the screen was fully raised simultaneously with the start of the latency timer and the duration counters. The previously described behaviors were recorded with the duration counters. The foot pedal was released to stop the latency timer at the end of the trial. Then the screen was lowered and the tray brought back to the starting position. The trial ended when the subject retrieved the raisin or when 60 seconds had elapsed, whichever occurred first. The food taking latency thus determined the maximum length of any recorded behavior for a given trial. The intertrial interval was 60 seconds. The subjects were deprived approximately 23 hours prior to each session and were fed their full daily ration after testing.

Adaptation occurred for all subjects one week prior to testing. Adaptation consisted of placing a raisin in the foodwell and placing the plexiglass box behind the foodwell. The criterion for adaptation was a latency of three seconds or less for 25 consecutive trials.

Adaptation and testing took place in a semi-darkened room. A 60-watt frosted incandescent light in the WGTA illuminated the stimuli. The duration counters emitted a sound loud enough to mask most external noises.

Results

Figure 1 shows the food taking latencies as a function of two day blocks for block, tube, unpainted snake, painted snake, and real snake stimuli. An analysis of variance showed a subsequent decrease in latencies over days [$F(6,36) = 5.087$; $P < .01$] as a result of habituation to the snake and snake-like stimuli. Duncan Range Tests showed no significant differences in latencies among the real snake, painted snake, and unpainted snake conditions. However, latencies in each of the three conditions were significantly greater ($P < .05$) than latencies in the coiled tube and block conditions. The latter two conditions were not significantly different.

Figure 2 depicts the mean duration per trial of locomotion, scanning, vocalization, and withdrawal in each of the five stimulus conditions. The graph clearly indicates that these behaviors were more frequent in response to the real, painted, and unpainted snake conditions than to the other two conditions. This is largely a reflection of the fact that there were latencies in response to the real, painted and unpainted snake than to the other two stimuli, and therefore more time for making these responses. There was a significant decrease in frequency of each of these fear behaviors over days [$F(6,36) = 5.94$, $P < .01$ for locomotion; $F(6,36) = 5.7$, $P < .01$ for scanning; $F(6,36) = 53.80$, $P < .01$ for vocalization; $F(6,36) = 5.82$, $P < .01$ for withdrawal]. Furthermore there were no significant differences among mean duration of these four behaviors.

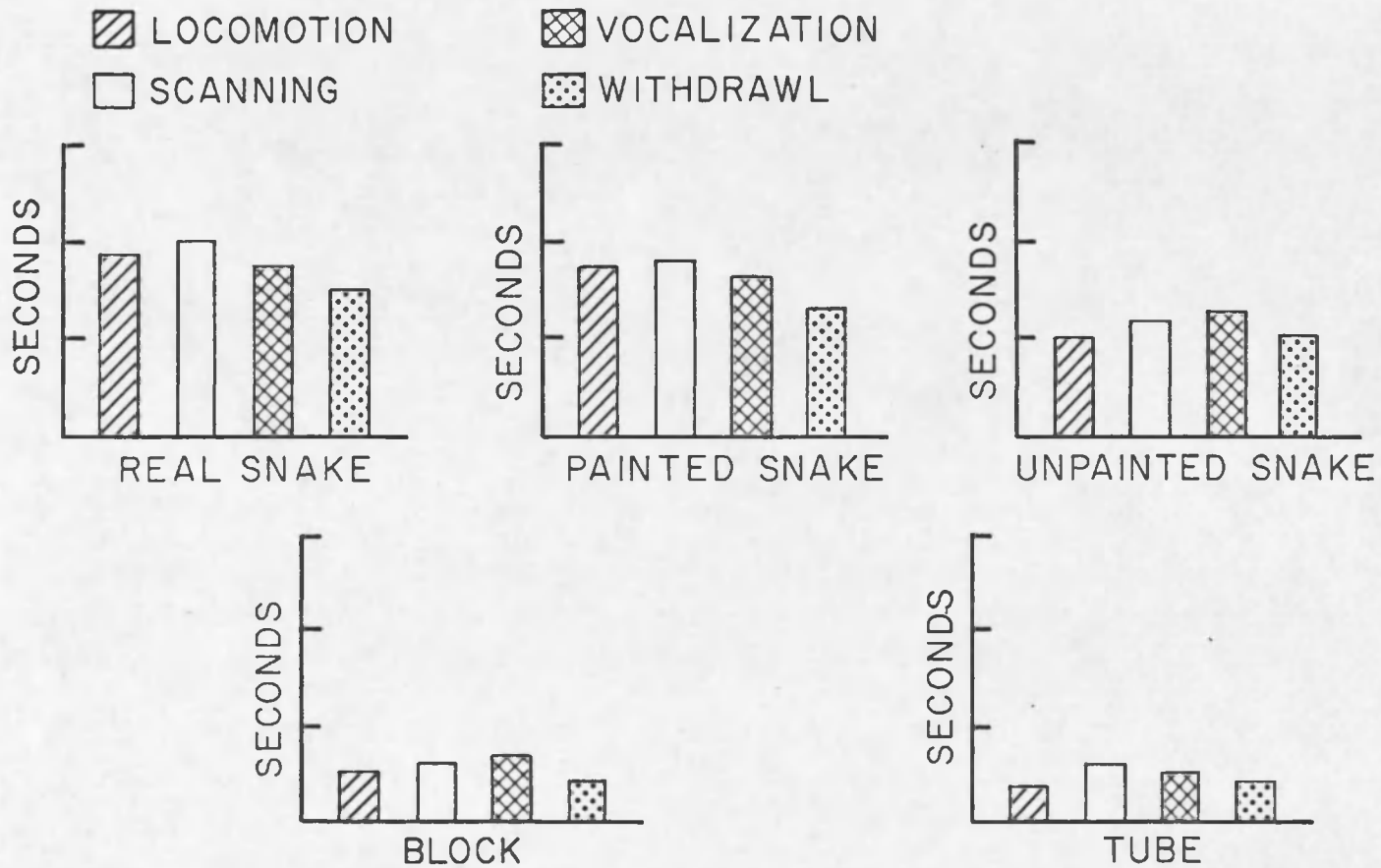


Figure 1. Mean Seconds per Trial for Scanning Locomotion Withdrawal Vocalization as a Function of Stimuli.

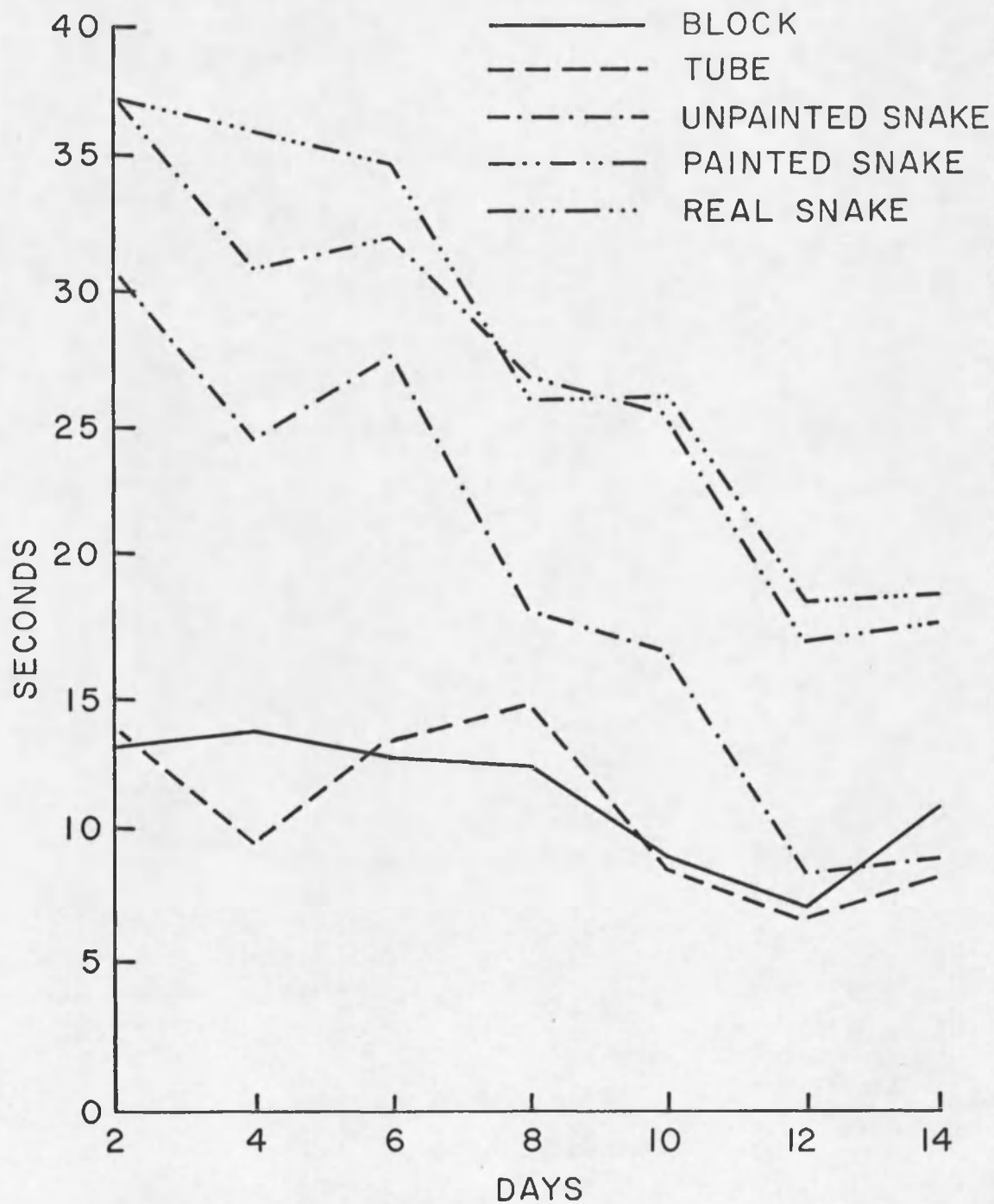


Figure 2. Mean Latency per Trial as a Function of Days and Stimuli.

The results of this study indicate that not only did the subjects habituate to their "natural predator" but also during testing the subjects demonstrated an interesting new type of behavior. This behavior started on the second day of testing. Originally, there was a grate constructed from 1" wire mesh which fit snugly on the floor of the test cage. On day two, one subject managed to get the grate up and climbed behind it. At this point, the experimenter sensed that this might be an interesting type of tool using behavior. So in order to facilitate subsequent tool using by the subjects, the grate was made smaller. Subsequently, all subjects manipulated the grate in a manner suggesting that it was being used as a shield between the subject and the snake. Table 1 summarizes the types of manifestations as a function of days. It should be noted that the grate was positioned almost always between the subjects and the snake; also, this occurred for real and rubber snakes and almost never occurred for tube or block. The frequency of these behaviors as a function of days and stimulus conditions is shown in Figure 3. Applications of an analysis of variance to the data from the real snake, painted snake and unpainted snake conditions showed a trial effect that was not quite significant [$F(6,36) = 2.35$; $F(6,36) = 2.36$ required for $P < .05$]. An Extended Alexander Test failed to show a significant linear or quadratic component to the trial effect.

Since virtually all scores in block and tube conditions were zero, an over-all analysis of variance on the tool using data could not be effected because of the resulting extreme heterogeneity of variance. Application of the Wilcoxon T-Test to the differences between means of

Table 1. Frequency of Tool Use Behavior in Two-Day Intervals.

Conditions x Days	1&2	3&4	5&6	7&8	9&10	11&12	13&14
Close to body	10	5	3	0	0	7	2
Crouches under	11	20	22	18	7	5	4
Partially up	8	3	2	2	0	0	0
All the way up	52	59	54	20	28	15	11
Reaches over	1	1	2	5	2	0	0
Reaches thru	13	7	7	20	3	2	1
Partially out of cage	1	13	14	21	15	10	10
Out of cage	0	8	15	5	6	7	6
Moves stimulus box	0	6	15	12	12	6	9

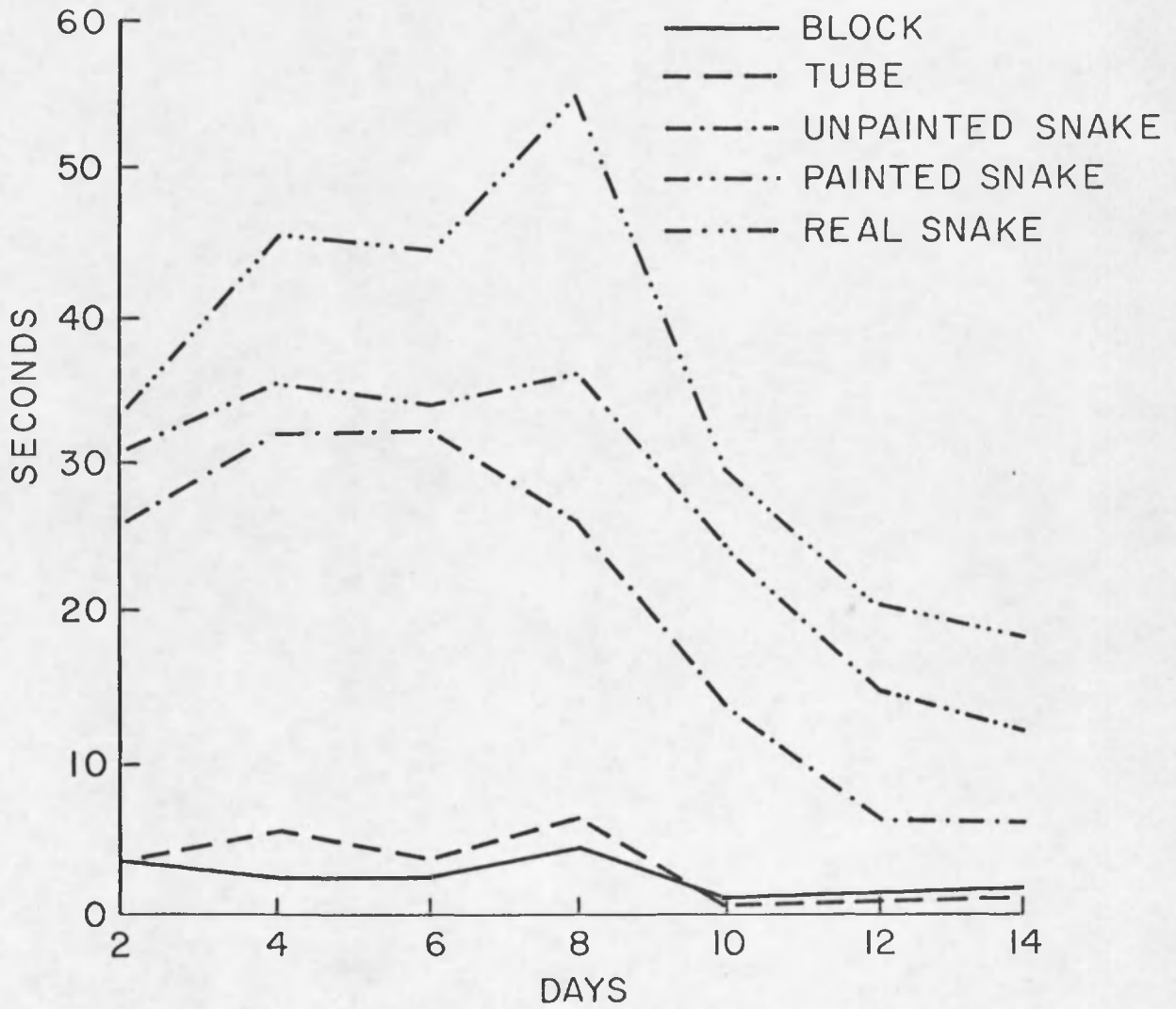


Figure 3. Frequency of Tool Use Behavior as a Function of Days and Stimuli.

the five conditions showed the following results: the real snake gave higher tool using scores than any of the other conditions ($P < .01$), the painted and unpainted snake conditions did not differ significantly but were both significantly higher than the blocks and tube conditions ($P < .01$), the later two conditions did not differ significantly.

Discussion

The present study indicated that feral capuchin monkeys fear a live boa constrictor, a painted rubber snake similar in coloring to the boa constrictor and an unpainted gray rubber snake more than a block and a tube. Proof was provided by the longer food taking latencies to the three snake conditions than to the block and tube.

Also, it is possible to conclude that habituation was clearly demonstrated. The response latency decreased as a function of days for the five stimulus conditions, real snake, painted snake, unpainted snake, block, tube and for the dependent measures of vocalization, locomotion, scanning and withdrawal.

The three snake conditions yielded significantly longer food taking latencies than either the block or tube conditions. However, there were no significant differences among the three snake conditions. Thus, snake shape rather than snake coloration was a more important determiner of food taking latencies. These results are similar to Murray and King (1973).

In most previous research where tool using behavior has been reported, it has occurred in happenstance and it has not been under experimental control (Lawick-Goodahl 1970). However, this technique proved

significant as the tool using or shielding behavior was brought under experimental control. They occurred a substantial amount of the time in the presence of the real snake, a lesser but still substantial amount of time in the presence of the painted snake and unpainted snake, and almost never in the presence of the block or tube. This is strong evidence that the behavior was not just random but was correlated with the presence of snake or snake-like stimuli.

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