Response to Infant Stimulus by Adult Male Common Marmosets

Background

Common marmosets are small monkeys in the family Callitrichinae (full grown adults average around 7–8 inches in height) native to a coastal region in northeastern Brazil. In the wild, they live in extended family groups with a limited number of breeding males and females, their offspring of various ages, and other closely related adults. In captivity, stable social groups are composed of a single breeding male and female and their offspring. The breeding female(s) will typically give birth twice per year to sets of nonidentical twins. In captivity, females can become pregnant again shortly after birth. All adults in the group, male and female, share in caring for the young. Marmosets reach sexual maturity and adult size by about age 15 months, but do not begin to breed unless they become dominant.

Paternal caretaking is an important aspect of the cooperative breeding structure and to infant survival in Callitrichine primates. Adult males engage in vigilance behavior, carry heavy twin infants in an arboreal environment, and engage in food sharing, grooming, and play with infants. Vigilance and protection of carried infants is particularly important as it lightens the energetic load on the breeding female(s), who in captivity may be lactating as well as pregnant from early post-partum ovulation. Some studies in other Callitrichines suggest that infant survival may be linked to the presence of adult males.

There is evidence in marmosets that fathers experience hormonal changes coincident with their mates pregnancy and in the presence of their infants or their infant's scents within the first couple months after birth with prolactin and estrogen levels increased and testosterone levels decreased. Nonfathers did not show similar hormonal responses in previous studies. The scientists want to better understand the possible effects of these hormones on subsequent parenting behavior by males. They have evidence from a number of species that for females, these hormone changes during pregnancy are driving subsequent maternal parenting behavior. They want to determine whether exposure to change in hormone levels affects male parenting behavior, specifically in care-taking responsiveness to infant distress calls. The experiment compares captive males who are fathers, breeding males that have the experience of a mate's pregnancy and caring for their own offspring, with paired nonfathers who are adult age and paired with a female, but have not yet fathered offspring. These paired nonfathers do have varying levels of offspring-rearing experience as older siblings, however.

The primary scientific questions are the following:

1. Are fathers more responsive to infant cues than are paired nonfathers with no offspring of their own?

2. How does treatment with exogenous hormones (estrogen or testosterone) affect responsiveness to infant cues? Are there differences between these hormones?

3. Are paired nonfathers stimulated by hormone treatments as responsive as untreated fathers?

4. How does the responsiveness of fathers depend on the ages of their current offspring?

Furthermore, the experimental conditions compare responsiveness to recordings of genuine infant distress calls and simulated control noises constructed to have similar acoustic properties. Previous studies have shown that both groups of males are more responsive to infant distress calls than control noises. Does this finding hold as well in this experiment?

Study Design

The experiment studied the behavior of 32 male marmosets, divided into four groups of eight each. Each group is distinguished by fatherhood (father/nonfather) and exogenous hormone (estrogen/testosterone). Each animal is observed six times, once for each combination of stimulus (control/distress) and exogenous hormone level (control/low/high). The order of these experimental conditions is randomized with one of the six possible orders of the three hormone levels selected. The order of the stimuli is randomized partially as well with the first and third hormone levels beginning with one stimulus first and the second hormone level beginning with the other stimulus first.

All response variables are measured during ten-minute observational periods in a testing apparatus designed for behavior testing located apart from their normal living area. For each hormone level for a given animal, measurements for the two different stimuli are taken a few days apart. The hormone treatments are administered by shot two to four days before the first observational period. The second observational period is three to four days after the first. Animals are given time in the testing cage on two separate days before the observational periods to become habituated with the testing environment.

The testing apparatus consisted of two cages combined by a bridge 'obstacle'. The male was brought to the apparatus from a different room, and his transport cage was attached to the 'home cage' section of the apparatus. On the other side of the 'bridge', the stimulus noise was played in a similarly constructed section called the 'stimulus cage'. As soon as the male was released into the home cage, the stimulus was started, the male was released, and the observations immediately began.

The behavior observation periods lasted 10 minutes so that each male had enough time to respond, but was not subjected to the prolonged psychosocial stress of the stimulus and the separation from their home cage. During the 10 minutes, each male was free to move throughout the entire testing apparatus.

For each 10 minutes of behavioral testing, a recording of an infant distress cry (which normally elicits retrieval behavior) was played continuously by an Mp3 player afixed to the top of a nestbox in the stimulus cage portion of the testing apparatus. The Mp3 player was in the same location across all trials. A control stimulus was played to the same male during a different trial of the same test phase.

Data

In each experimental condition for each animal, there are 13 different response variables that were measured, labeled behaviors A through M. Each measurement takes the form of a count of the number of times that the animal expressed a given behavior during a ten-minute observational period. Some of these behaviors are never observed. Other behaviors are more

difficult to connect to scientific hypotheses directly. The data set you have contains only a subset of the 13 response variables.

B. — Look at stimulation cage.

D. — Enter stimulation cage.

H. — Enter home cage.

I. — Enter bridge.

J. — Investigate home nest box.

K. — Look at stimulus Mp3 player.

L. — Enter home nest box.

M. — Investigate stimulous nest box.

Behaviors D, M, and I are most directly related to hypotheses of interest and should receive your primary attention. Behaviors B and K are less active responses to the stimulus, but still of interest. For the remaining behaviors, it would be sufficient to explore potential graphical evidence of interesting relationships with explanatory variables.

The data set also includes several explanatory variables. There is an id for each male. The explanatory variables incorporated in the design were fatherhood status, hormone and level, and stimulus. Other variables are included as they vary among the males and may help to explain differences in behavior not incorporated into the design. These variables include the weight of the male on the date of the injection, the date of birth of each male, the date of each injection (from which the age of the male can be determined), the age of the youngest offspring (if any) living with the fathers at the time of measurement, an indicator whether or not the animal had previous exposure to the testing apparatus, the number of litters of younger siblings the male helped to raise, and the number of litters of previous offspring the male helped to raise. It is not known how much previous experience with infants, whether as a father or older sibling, might affect behavior. Age and mass are not thought to be informative for predicting behavior, but there may be noteworthy patterns. The age of offspring might affect the base hormone levels of the males. In particular, very young infants must be carried continually. Marmosets are weaned after about six weeks. Presence of infants under the age of six weeks may be associated with different hormone levels in males. Furthermore, there is some missing data when a male was not observed during one or more planned observation periods.