Numerical Discrimination Experiment

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Subjects: Cotton-top tamarins (DD, DW, JK, KW)

Goal:

The goal of the "numerical discrimination" experiment is to characterize the tamarins' ability to distinguish between to different quantities of food. Studies on rhesus monkeys contend that they conform to Weber's law by discriminating small differences in reward amounts better if the magnitude of the amounts is small rather than large (Brannon and Terrace 1998). Recent work, however, suggests that rhesus monkeys and human infants may use a different mechanism (object-file system) to distinguish small numbers such as 1-3 (Wynn 1998; Hauser et al. 2000; Feigenson et al. 2002). Because subjects in these studies could not discriminate pairs of numbers with similar ratios but different magnitudes (e.g., discriminate 1 vs. 2 but not 4 vs. 8), a more precise mechanism may track small amounts, whereas a more approximate mechanism tracks larger amounts. Previous data describes the tamarins ability to discriminate small quantities of food (Uller et al. 2001) and acoustic cues of number (Hauser et al. 2002; in press). An experiment similar to this one found that rhesus monkeys could discriminate 1 vs. 2, 2 vs. 3, 3 vs. 4, and 3 vs. 5 but not 3 vs. 8, 4 vs. 5, 4 vs. 6, 4 vs. 8, or 5.vs. 6 (Hauser et al. 2000). We predict that the tamarins will have numerical distinction patterns similar to those of rhesus monkeys and human infants, distinguishing numbers 1-3 but having difficulty discriminating small differences between larger numbers. Note, however, that we are not interested in whether the tamarins discriminate number *per se* or some other proxy for amount (such as surface area).

Procedure:

To assess the tamarins' ability to distinguish numerical payoffs, we will use a standard choice task in which a single subject chooses one of two amounts of food (banana-flavored primate pellets). We will place each subject in a cage with a transparent wall facing two food bins (Figure 1). We will place either a small or large reward inside bin. The subject can draw one of the rewards into reach by pulling one of the crossbars toward an opening near the bottom of the transparent wall. Subjects can only choose one bin because both bins cannot be reached simultaneously, and the non-chosen bin is removed immediately. We will offer the subjects the following sets of reward pairs: (0,1), (1,2), (1,3), (1,4), (2,3), (2,4), (2,5), (3,4), (3,5), (3,6), (4,5), (4,6), (4,7). We will use four trials of the (0,1) set to ensure that the subjects are motivated and attending to the sets. We will randomize the order of the sets (with a (0,1) set as the first trial of the session) and the side on which we place the large rewards.

Each subject will undergo a daily session of 12 test trials, each of which is a different, randomly-ordered numerical pair, plus four (0,1) trials. The subjects will experience 12 replicates for each of the 12 numerical pairs.

Trial structure

- Insert white barrier between front panel and bins. To begin a trial, place food in specified indentations in food bins according to the trial type (Figure 1).
- Situate tools such that both crossbars are flush against white barrier.
- Remove front barrier. After 5 seconds, push both bins forward simultaneously.
- The subjects get 5 seconds to make a first attempt to pull the crossbar and 30 seconds to get the food. If they subject does not touch the crossbar after 5 seconds or retrieve the food after 30 seconds, slide the bins back, remove the food, and replace the barrier.
- If the subject does touch a crossbar, slide the other bin out of reach.

- After the subject obtains the food, draw the bin out of reach, remove all unconsumed food from, and replace the barrier.
- Record no pull (N), right pull (R) or left pull (L)—right and left are from the experimenter's perspective—and the amount received. Wait 5 seconds after the barrier is replaced before getting food for next trial. Repeat until all trials are completed.

- Please transfer all data to computer files when you are finished for the day.

Training criteria:

- To move from initial training to an experimental session, the subjects must make no more than **two** errors for **two** concurrent sessions.
- If in the experimental sessions the subject pulls the 0 tools twice, abort the session and run a training session in the subsequent session.
- If in the experimental sessions the subject makes 5 or more mistakes and 4 or more of these are on the same side this indicates a side bias. In the subsequent session, run a training session focusing on the opposite side as their bias.
- To move from these training sessions back to an experimental session, the subjects must make no more than **two** mistakes in a single training session.

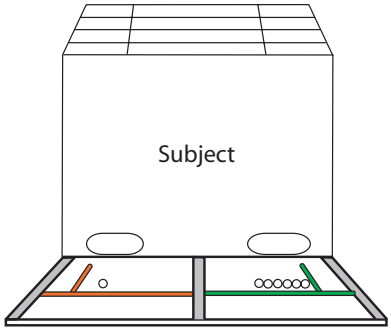

Figure 1: Single subject in transport cage will face choice task with two L-shaped tools.

Trial type generator:
`http://www.wjh.harvard.edu/~mnkylab/apps/num-trialtype.html`

References:

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