Cayo Santiago Three (Minus One) Cup Task Control (#207273)

Author(s)
This pre-registration is currently anonymous to enable blind peer-review.
It has 4 authors.

Pre-registered on: 01/10/2025 05:57 AM (PT)

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
Previous work shows that a basic logical operation-the disjunctive inference (e.g., the hidden object is an apple or a stone; it is not a stone; therefore, it must be an apple)- is deployed by infants to infer the identities of objects (Cesana-Arlotti et al., 2018, 2020, 2022). Additionally, recent work has shown evidence that adults deploy spontaneous and irresistible disjunctive inferences in an object recognition task (Braswell, Firestone, and Cesana-Arlotti, in prep.). Taken together, these data point toward prelinguistic, developmentally primitive, and procedurally automatic logical operations in human cognition.

But if logical capacities are basic, automatic, and independent of language, then the same logical resources may be evolutionarily primitive and present in non-human animals. Previous research has attempted this question in nonhuman primates (Call, 2004, 2006; Ferrigno, Huang, & Cantlon, 2021) with inconclusive results (Mody & Carey, 2016; Leahy and Carey, 2020; Engelmann et al., 2023). However–in a previous study–we found evidence that nonhuman primates (free-ranging rhesus macaques, Macaca mulatta, living at the Cayo Santiago Biological Field Station) may be able to distinguish between logically certain and uncertain outcomes. Here, we rule out two alternative explanations of these results: 1) that subjects were merely responding to lower-level asymmetries in the stimuli (e.g., two cups on one side vs. one on the other) or 2) that subjects were merely avoiding the non-rewarding item (e.g., the rock). The procedure will be identical to the previous study, except that a rock–instead of an apple–will be hidden in a standalone cup (i.e., the single-cup side). If rhesus macaques can distinguish between the possibility of the reward on the double-cup side from the impossibility of the reward on the single-cup side, they should approach the double-cup side in over 50% of all trials. Alternatively, if they were previously responding to some other non-logical feature in the task, they should not be significantly above chance at approaching the double-cup side.

3) Describe the key dependent variable(s) specifying how they will be measured.
Choice when approaching: Which of the two sides of the apparatus the subject approaches first. When the subject is within reach of one of either the single-cup side or the paired-cup side, the trial will conclude and the choice will be recorded.

4) How many and which conditions will participants be assigned to?
There will be eight between-subjects conditions. For half of the subjects, the paired-cup side will appear on the monkey's left and the single-cup pair will appear on the monkey's right; for the other half, the order will be reversed. For half of the subjects, the apple and the rock will be placed on the paired-cup side first, and the rock will be subsequently placed on the single-cup side. For the other half, this order will be reversed. Finally, the experimenter will remove the left cup from the paired-cup side on half of all trials and remove the right cup from the pair on the other half. All conditions are counterbalanced between subjects and collapsed for the purpose of our analysis. Monkeys will be randomly assigned to one of the eight conditions by a random condition generator controlled by the camera-person, who will be blind to the specifics of the condition.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
We will conduct a one-tailed binomial test to determine whether the proportion of double-cup side choices in our sample is significantly higher than 50%, using a significance level of 0.05.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
If the trial is interrupted (due to interference by another monkey, premature curiosity, the subject walking away, or experimenter error) before the experimenter can finish the demonstration, then the trial will be considered incomplete and not assigned a trial number. Upon completion of the demonstration, the subject will have 30 seconds to approach the apparatus and make a choice. If another monkey approaches the subject or the apparatus within this time, the trial will be excluded for interference. If the subject walks out of sight of the apparatus within this time, the trial will be recorded as a walkaway. Finally, if the subject does not approach the apparatus within arm's length during the 30-second long observation period, the trial will be recorded as no approach. Trials in which the subject approaches but does not come within an arm's length of one of the apparatus plates will be recorded as no approach.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
We will continue to collect data until we reach a sample of 30 to 50 subjects, post-exclusions. Once 30 subjects have been tested, we will continue to test either until mean age and gender are approximately equivalent between conditions or until we reach 50 subjects, post-exclusions. If the minimum number of subjects is not met on this data collection trip, the study will be concluded on a separate data collection trip.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

*Madeline Meade is co-first author