Cayo Santiago Three (Minus One) Cup Task (#178249)

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

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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; its 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 preverbal infants have basic logical capacities, then these cognitive resources might be language independent and possibly in place 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). The current project aims to contribute to this debate by probing the logical capacities of rhesus macaques.

In this study, subjects (free-ranging rhesus macaques, Macaca mulatta, living at the Cayo Santiago Biological Field Station) will be shown a novel variation of the three-cup task (Mody & Carey, 2023) wherein two rewards (small apples) and one non-reward (a rock) will be hidden in one of three cups. One apple will be hidden in a standalone cup (i.e., the single-cup side), and the other apple and the rock will be ambiguously hidden in the remaining two cups (i.e., the paired-cup side), such that the subject is unaware which cup in the pair contains the reward. Upon removing one of the cups from the pair, the experimenter will walk away and allow the subject to approach the apparatus. If rhesus macaques can distinguish between the certainty of the reward on the single-cup side from the uncertainty of the reward on the paired-cup side, they should approach the single-cup side first at rates above 75% of the time. Alternatively, if they are merely simulating one of the reward's possible locations on the paired-cup side, they should approach the single-cups side about 75% of the time (Leahy and Carey, 2020, Leahy et al., 2023).

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 macaque gets 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 apple 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 the cameraperson, 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 plan to conduct a one-tailed binomial test to determine whether the proportion of single-cup side choices in our sample is significantly higher than 75%, 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, 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 one minute 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 minute long observation period, the trial will be recorded as no approach. Trials in which the subject approaches but does not come close enough to reach inside one of the cups 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 40-60 subjects, post-exclusions. Once 40 subjects have been tested, we will continue to test

either until mean age and gender are approximately equivalent between conditions or until we reach 60 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?)
No, nothing else to preregister.