Mathematics in Primates

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ABSTRACT

As humans learn more and more every day, we can assume that other species are advancing as well. Humans come from primates, but how different are we? Whether we realize it or not, we are solving arithmetic and other math problems every day. Since we share so many characteristics with our primate ancestors, we must assume that primates and apes alike should show characteristics of solving problems like us. Through research, we can prove that chimpanzees have been able to distinguish groups based on a proportional number and able to identify Arabic numerals that coincide with the correct number of items in front of them. However, through our research, we will identify if these animals can do math or if it is more of a memory test/muscle memory because they can understand they will be rewarded. This research will investigate these animals and experiments done on them to find if they are truly able to comprehend arithmetic problems, if they can solve simple problems, or if they can identify the right amounts at least. Chimpanzees have been noted to be able to identify the correct number of oranges and other fruits given to them by pointing to the correct number. Monkeys can distinguish smaller numbers when given a list of numbers with few incorrect trials. We believe that this feat isn't driven by rewards or by their memory, but truly the fact that these animals can do simple math.

INTRODUCTION

In this project, we will explore the similarities between humans and their primate ancestors. Although these animals are not on the same level of arithmetic as we are, they still display a great understanding of basic mathematic principles. Not only do these primates display knowledge of mathematics, but they can respond with speed that nearly rivals human reaction time and have shown the ability to learn from past trials to do better as they continue.

METHODS

We have searched and found research from the following data places and locations:

- Michael Schwartz Library
- Google Scholar
- Cleveland State's Online library catalog

Figure 1. One experiment to prove the cognitive ability to count

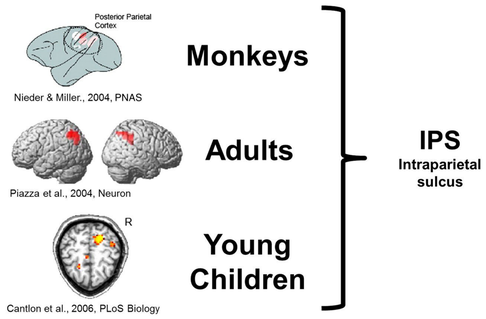

Figure 2. Similar activation in the brain in monkeys, adults, and young children when doing numerical processing

TESTING

Addition Test:

- Two screens were displayed with 1,2, or 4 dots.
- Two trained monkeys would view two separate screens with dots.
- After the monkeys viewed the two separate screens, they were given a choice of two answers, one wrong and one correct.

Both monkeys performed well in the study and got slightly better at the addition as they tried more sessions of addition. The increase in percentage right may be due to the training or monkeys recognizing patterns. Overall, the experiment shows simple addition is something monkeys will get right most of the time.

Comparing Quantities Test:

- First, the apes were tested on their preference for food, banana pellets or carrot pellets which both have distinct colors.
- Once that was decided two clear buckets were filled with pellets. One was mostly carrot pellets the other mostly banana pellets.
- The person would grab a pellet from each bucket hiding the color of the pellets and allowing the ape to decide which bucket he wanted his pellet from based on their preference in food.

The results show that over the 6 times tested, the ape 70% or more of the time chose from the bucket that had a higher ratio of their preferred food choice. Showing their ability to factor in the quantity of food in their decision.

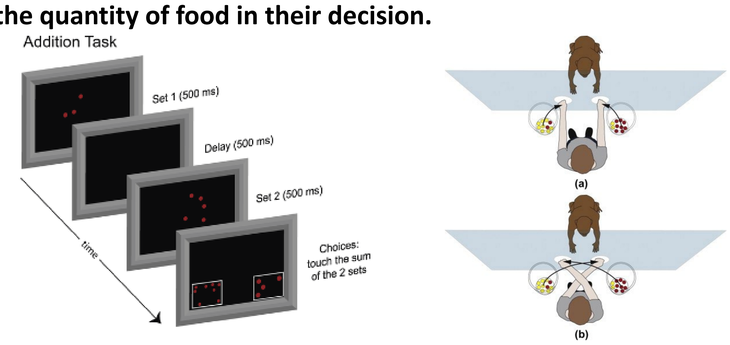

Figure 3. Addition Test(left) and Comparing Quantities Test(right)

RESULTS

The use of Math in monkeys and apes can be separated into broad categories. The natural use of math comes from apes' and monkeys' cognitive ability to discern large or scarce amounts of food. When trained and ran through nonverbal numerical counting in a way that while not as proficient can be compared to humans. Monkeys and apes use the same parts of their brain for math that humans use. The use of simple arithmetic, comparing values and counting triggers the use of the intraparietal sulcus. This is true for humans and apes. It has been concluded through different studies that simple math is more primal than taught. Natural intelligence apes are comparable to infants. Not counting but comparing the frequency of objects is in their realm of capability. They can decide which of the two buckets has more food. This comes without training. The ability to count, compare values, and simple arithmetic can be viewed as more primal, Apes and Monkeys lack something humans have while training their math skills. The ability to improve at certain problems through practice. This hinders expanding concepts and limits the maximum potential of cognitive abilities in apes and monkeys. This is due to years of evolution that caused this hindrance in apes but not humans.

DISCUSSION/FUTURE WORK

Future work would involve expanding to more primate species, conducting different tests, and integrating neurological analysis for deeper insights. Interdisciplinary efforts could further explore the evolutionary and cultural influence on mathematical abilities.

CONCLUSIONS

The use of math in monkeys and apes can be categorized into natural and trained abilities. Natural math abilities stem from their cognitive capacity to discern large or scarce amounts of food, like human infants. They can compare quantities without specific training, such as discerning which bucket has more food based on their preference. However, when trained, monkeys and apes can demonstrate nonverbal numerical counting skills, although not as proficiently as humans. Studies have shown that they use similar brain areas as humans for tasks like simple arithmetic and comparing values. However, their ability to improve through practice is limited compared to humans, likely due to evolutionary differences. Overall, while monkeys and apes possess natural math abilities, their potential for improvement through practice is limited compared to humans.

References

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