S-IC Sarah, the chimpanzee

Alignments to Content Standards: S-IC.A.2

Task

Many researchers have studied chimpanzees to learn about their problem solving skills. In 1978, researchers Premack and Woodruff published an article in Science magazine, reporting findings from a study on an adult chimpanzee named Sarah, who had been raised in captivity and had received extensive training using photos and symbols. In one experiment, Sarah was shown videotapes of eight different situations in which a human being was faced with a problem. After each videotape showing, Sarah was presented with two photographs, one of which depicted a possible solution to the problem. The researchers ensured that the order in which the photographs were presented was randomized (for example, the correct answer was not always presented first, etc.) and that the photographs had similar visuals (for example. similar colors, etc.) Of the eight problems, Sarah picked the photograph with the correct solution seven times. Could Sarah have been merely guessing and just lucky with her responses, or is there evidence that Sarah does better than just guessing?

a. Give two *possible* explanations for why Sarah might have answered seven out of eight correctly.

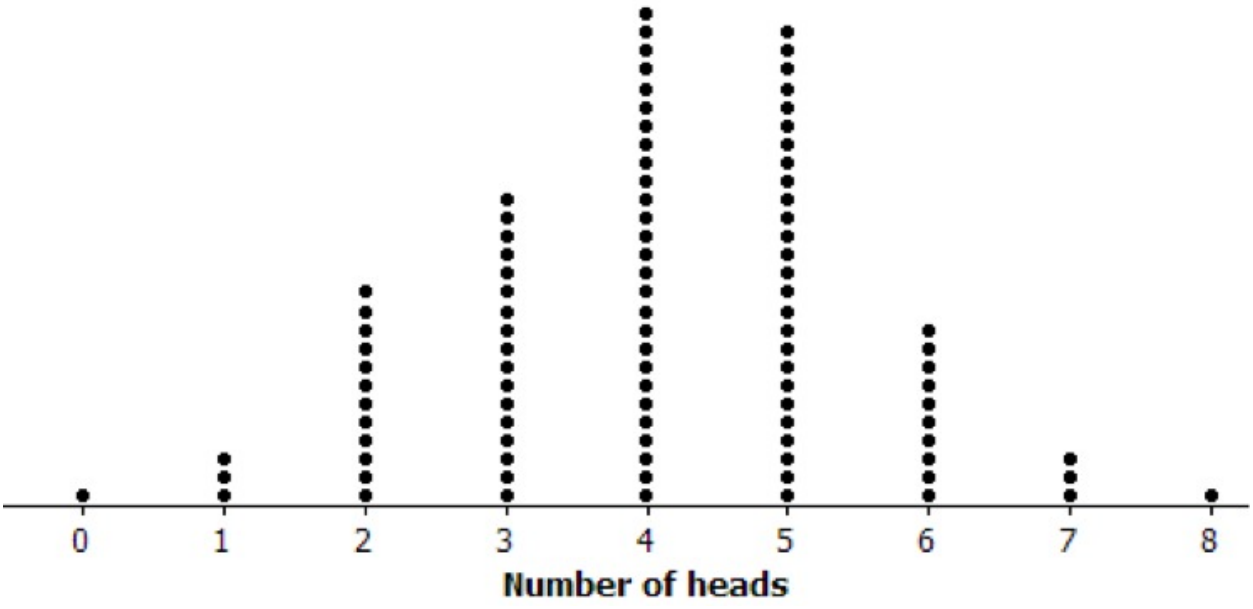
b. If Sarah were just guessing, and was just likely to pick one photograph compared to the other, how many would you expect her to get right out of eight problems?

c. Give an example of how you could use basic classroom tools (coins, dice, calculators, cards, etc.) to simulate one trial of Sarah “just guessing” to pick a photograph for one problem.

d. A student, James, decides to use simulation to investigate whether the study data provide evidence that Sarah was doing better than just randomly guessing, and so James tosses a coin eight times, and obtains six heads. Explain why James should repeat the process of tossing the coin eight times and recording the number of heads,

many times.

e. James repeats the process of eight coin-tosses 100 times, each time recording the number of heads on the eight coin-tosses. The following is a dotplot of his results.



Based on the above dotplot, what was the most common result for "number of heads" in eight coin-tosses? Why does this make sense?

f. Based on this dotplot, would you say that a score of 7 out of 8 would be unusual if Sarah has just been guessing? Why or why not?

g. Which of the following is a *possible* explanation for Sarah's performance?

i. Sarah had been just guessing and got lucky with her responses.

ii. Sarah does better than just guessing.

iii. Both (i) and (ii) are possible explanations.

h. Based on the simulation results, which of the following appears to be a *plausible* (likely) explanation for Sarah's performance?

i. Sarah had been just guessing and got lucky with her responses.

ii. Sarah does better than just guessing.

iii. Both (i) and (ii) are possible explanations.

i. Based on the results of this study, would it be reasonable to say that all chimpanzees do better than just guessing when faced with the kind of problems posed to Sarah? Explain why or why not.

IM Commentary

The purpose of this task is to give students experience in using simulation to determine if observed results are consistent with a given model (in this case, the "just guessing" model). The final part of the task also addresses the role of random assignment in the design of an experiment and assesses understanding of this concept.

If students have not yet had much experience with simulation, they may need guidance in setting up the simulation in part (c) and in understanding how tossing eight coins models the random guessing situation descried in the task. It might be helpful to ask students to think about how flipping a coin can be viewed as equivalent to a guess.

In the discussion of parts (g) and (h), focus on the fact that while 7 out of 8 correct is not an impossible outcome for a chimp who is guessing, it is still an unusual or surprising outcome. A more likely explanation for what was observed in the study is that Sarah is not just guessing. This type of reasoning is the foundation for later work with drawing conclusions from data.

For the full Science article, see Premack, D. and Woodruff, G. (1978a), Chimpanzee problem-solving: a test for comprehension, Science 3 November 1978, Vol. 202 no. 4367 pp. 532-535.

Edit this solution

Solution

a. Either Sarah was randomly guessing and got lucky *by chance*, or Sarah does better than randomly guessing.

b. If Sarah had been guessing, we would expect her to get 4 (half of eight) correct. (Instead she got seven right. The question is, *Is seven out of eight different enough from four out of eight to conclude that Sarah was doing better than just guessing?*)

c. Use a coin flip; heads for correct answer and tails for incorrect answer. Or, a die;

even number for correct answer and odd for incorrect.

d. Because James needs to see what happens in the *long-run* on eight coin-tosses. What outcomes are more common? What outcomes are less common? How often does 7 heads in eight coin-tosses happen just by chance?

e. Most common outcome is 4 - which makes sense because that is what we expect would happen if Sarah was randomly picking a photograph.

f. 7 is unusual (surprising) because on the 100 tosses, an outcome as or more extreme as 7 happened by chance only 4 times.

g. (iii) Both (i) and (i) are possible explanations

h. (ii) Sarah does better than just guessing.

i. The question of interest is about Sarah getting the answer right, rather than about all chimpanzees. Note that Sarah's trials are not a random sample from the population of all possible chimp responses.