Activity 1: Naughty or Nice?

Do children less than a year old recognize the difference between nice, friendly behavior as opposed to mean, unhelpful behavior? Do they make choices based on such behavior? In a study reported in the November 2007 issue of *Nature*, researchers investigated whether infants take into account an individual’s actions towards others in evaluating that individual as appealing or aversive (Hamlin, Wynn, and Bloom, 2007). In one component of the study, 10-month-old infants were shown a “climber” character (a piece of wood with “google” eyes glued onto it) that could not make it up a hill in two tries. Then they were alternately shown two scenarios for the climber’s next try, one where the climber was pushed to the top of the hill by another character (“friend”) and one where the climber was pushed back down the hill by another character (“foe”). The infant was alternately shown these two scenarios several times. Then the child was presented with both pieces of wood (representing the friend and the foe) and asked to pick one to play with. Videos of this study are available at: www.yale.edu/infantlab/socialevaluation/Helper-Hinderer.html

a) Identify the
   a. Observational units:

b. Variable:

c. Is the variable Categorical or Numerical (Quantitative)?

d. What is the research question for this study?

Researchers found that 14 of the 16 infants in the study selected the nice toy.

b) Determine the proportion of infants who selected the nice toy.
c) Suggest two possible explanations for this result that the researchers observed.

d) Suppose for the moment that the researchers’ conjecture is wrong, and infants actually have no preference for either type of toy. Would it be possible to have obtained a result as extreme as the researchers found?

e) Again suppose that infants have no preference. How many of the 16 would you expect to select the nice toy? Would you always expect to see that many of the 16 infants select the nice toy? Explain briefly.

f) In your judgment, how many infants, out of the 16, would have to select the nice toy in order for you to be fairly well convinced that the researchers’ conjecture is correct, that infants really do have a tendency to prefer the nice toy? Explain your reasoning.

The key question here is to determine what results would occur in the long run under the assumption that infants actually have no preference. (We will call this assumption of no genuine preference the null model or null hypothesis.) We will answer this question by simulating (artificially re-creating) the selection process of 16 infants over and over, assuming that infants actually have no genuine preference.

g) Describe how we could use a common device to simulate the infants’ selection process.
h) Okay! Flip a coin 16 times. Record the number of heads that you obtain, which represents the number of your 16 hypothetical infants who choose the nice toy.

i) Combine your simulation results with your classmates. Produce a well-labeled dotplot. Identify the observational units, variable(s), and variable type(s) in the resulting dotplot.  

Observational units:

Variable(s):

Is / are the variable(s) Categorical or Numerical (Quantitative)?

j) Where is the distribution of number of heads in 16 tosses centered?

Explain why this makes sense.

k) Looking at this dotplot, does it seem that the result obtained by the researchers would have been surprising if in fact the infants had no preference?

What does this suggest about whether the researchers’ result provides much evidence that the infants do genuinely prefer the nice toy? Explain your reasoning.
We really need to simulate this random selection process hundreds, preferably thousands of times. This would be very tedious and time-consuming with coins, so we’ll turn to technology.

l) Use the “One Proportion” applet (www.rossmanchance.com/ISlapplets.html) to simulate the random process of 16 infants making this toy choice, still assuming the null model that infants have no real preference and so are equally likely to choose either toy. (Start with 1 repetition, and click the “16 tosses” button. Repeat this a total of 5 times. Then ask for 20 repetitions and watch the results. Finally, change the number of repetitions to 975, which will produce a total of 1000 repetitions.) Describe the shape of the resulting dotplot, and comment on whether it is centered where you expected.

m) Based on your simulation results, would you say that it would be very surprising, if infants actually have no genuine preference, that 14 out of 16 infants in the study would have chosen the nice toy just by chance? Explain.

n) Report how many of your 1000 repetitions produced 14 or more infants choosing the friend toy. Also determine the proportion of these 1000 repetitions that produced such an extreme result.

Paste a screenshot of your simulation run below – be sure to include the entire simulation screen:
• This proportion is called an approximate p-value. A p-value is the probability of obtaining a result as extreme as the one observed, assuming that there is no genuine preference/difference.

• A small p-value casts doubt on the null model/hypothesis used to perform the calculation (in this case, that infants have no genuine preference).
  o A p-value of .10 or less is generally considered to be some evidence against the null model/hypothesis.
  o A p-value of .05 or less is generally considered to be fairly strong evidence against the null model/hypothesis.
  o A p-value of .01 or less is generally considered to be very strong evidence against the null model/hypothesis.
  o A p-value of .001 or less is generally considered to be extremely strong evidence against the null model/hypothesis.

o) Is this proportion small enough to consider the actual result obtained by the researchers surprising, assuming the null model that infants have no preference and so choose blindly between the two toys?

p) In light of your answers to the previous two questions, would you say that the experimental data obtained by the researchers provide strong evidence that infants in general have a genuine preference for the friend toy over the foe toy? Explain the reasoning process behind your answer.
q) In a follow-up study, the researchers repeated this protocol but without the googly eyes on the helper. In this study, they found that 10 of the 16 infants chose the helper toy. How does this change your p-value and conclusions? [Hint: Use your earlier simulation results but explain what you are doing differently now to find the approximate p-value.]

Explain why your answers make intuitive sense.

Explain how this result contributes to the theory that infants are reacting to the social interaction of the toys.

Paste a screenshot of your new modified simulation run below – be sure to include the entire simulation screen:

Mathematical note: You can also determine this probability (p-value) exactly using what are called binomial probabilities. The probability of obtaining $k$ successes in a sequence of $n$ trials with success probability $\pi$ on each trial, is: $\binom{n}{k} \pi^k (1 - \pi)^{n-k}$. 
r) Use this expression (or more simply, use the Excel `binom.dist.range` command!) to determine the exact probability of obtaining 14 or more successes (infants who choose the helper toy) in a sequence of 16 trials, under the null model that the underlying success probability on each trial is 0.5.

*Be sure to show all of your work (or a complete screenshot!) below to justify your ‘exact probability’ calculation.*

The exact p-value (to four decimal places) turns out to be .0021. We can interpret this by saying that if infants really had no preference and so were randomly choosing between the two toys, there’s only about a 0.21% chance that 14 or more of the 16 infants would have chosen the helper toy. Because this probability is quite small, the researchers’ data provide very strong evidence that infants in general really do have a preference for the nice (helper) toy.