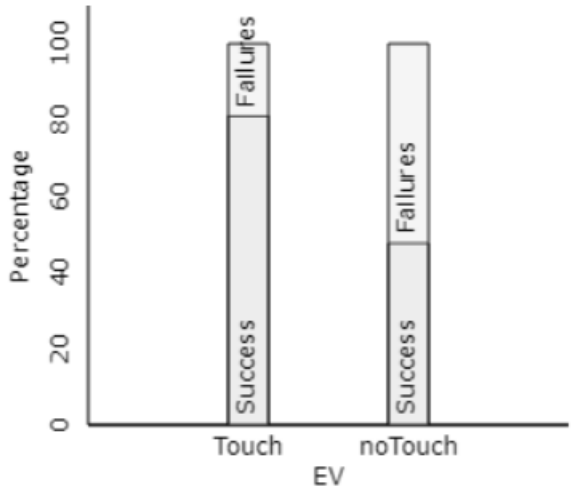
Solutions for Exploration 5.2: Robot Touch and Compliance?

1. a. Some students will comply without the robot touch and researchers want to see if the robot touch increases compliance above this baseline.
   b. Random assignment was used to equalize confounding variables so that if a significant difference between the groups is found, causal conclusions can be made.
   c. Randomized experiment; the researchers manipulated the explanatory variable by randomly assigning students to a treatment (robot touch or control).
   d. No random sampling was used as the students were volunteers. If the population were the entire students body, a random sample could be accomplished by numbering each student from 1 to the total number of students and then using a random number generator to randomly select 42 numbers in that range which would correspond to the 42 randomly selected students.
2. Explanatory variable is robot touch (yes or no) and is binary categorical; response variable is compliance (yes or no) and is also binary categorical.
3. Null: Robot touches don't increase compliance; Alternative: Robot touches increase compliance
4. Likely there is not an association
5. Likely is an association
6. Null: There is not an association between robot touches and compliance; Alternative: There is an association between robot touches and compliance where probability of compliance increases when the robot touch is present.
7. Null: The long run proportion of compliance for the robot touch group is the same as the long run proportion of compliance for the control group; Alternative: The long run proportion of compliance for the robot touch group is greater than the long run proportion of compliance for the control group; Ho: $\pi_{Robot\ touch} = \pi_{Control}$; Ha: $\pi_{Robot\ touch} > \pi_{Control}$
8. 2x2 table

	Robot touch	No robot touch	Total
Student complied	17	10	27
Student didn't comply	4	11	15
Total	21	21	42

9. Proportion who complied in robot touch group: 17/21 = 0.810
   Proportion who complied in control group: 10/21 = 0.476
   Difference in conditional proportions: 0.333
10. Segmented Bar graph



11. a. Yes
    b. Yes
12. There is no difference in the probability of compliance and just by random chance more students who were compliant were randomized to the robot touch group; Robot touch does increase the probability of compliance.
13. A. Answers will vary. One example is given here to facilitate follow up questions

	Robot touch	No robot touch	Total
Student complied	13	14	27
Student didn't comply	8	7	15
Total	21	21	42

    b. Answers will vary. Those given here go with above table.
    (Simulated) Proportion who complied in treatment group: 13/21 = 0.619
    (Simulated) Proportion who complied in control group: 14/21 = 0.667
    (Simulated) Difference in conditional proportions (treatment – control): 0.619 – 0.667 = -0.048
    c. Yes
14. a. 12 compliers; 12/21 - 15/21 = -0.143
    b. Trial 2: -0.048 Trial 3: 0.238 Trial 4: -0.238 Trial 5: -0.048
15. a. Yes, the null hypothesis suggests the difference in proportions will be zero
    b. Yes, 0.333 is out in the tail of the null distribution, it is a surprising result when the null is true
    c. 0.333; more
16. p-value ≈ 0.025
17. Under the assumption that robot touch has no association with compliance, if we repeated the shuffling/dealing many, many times, the probability we would obtain a difference in conditional proportions as or more extreme than 0.333 is about 0.025.
18. Based on the p-value of 0.025 there is strong evidence that a robot touch will yield a higher likelihood of compliance.
19. a. 0.333
    b. 0.150
    c. 0.333 ±2(0.15), (0.033, 0.633)

d. Only positive values

e. Since the 95% confidence interval for $\pi_{robot\ touch} - \pi_{control}$ doesn't contain zero and is entirely positive it is plausible that the probability of compliance is higher in the robot touch group than in the control group.

20. Yes, the proportion of compliers is 0.333 higher in the robot touch group than the control group and this is unlikely due to chance since a difference this large or larger rarely happens just by random chance.
21. Yes, because it is a randomized experiment
22. The sample was comprised of volunteer students, so caution should be used in generalizing. Results can be generalized to students similar to those in the study.
23. Type I error (false positive); We rejected the null hypothesis and there is a small chance that the null is plausible and we would have falsely concluded that a robot touch increases the probability of compliance to a request.
24. Collecting a random sample of students would allow for a broader generalization of results. A larger sample is likely needed. Robot touch should be applied in the same way to each participant and roughly at the same time in the session. The request mad follow in the robot touch should also come at roughly the same time after the touch occurs for each participant.
25. 1
26. Null: The relative risk of complying with a robot touch to complying without a robot touch is one.
27. Alternative: The relative risk of complying with a robot touch to complying without a robot touch is greater than one.
28. 1.7
29. They are the same.
30. If there were no association between robot touch and compliance we would expect 64% compliers in each group; this is about 13.5 in each group. Since we can't have half a person, we would expect either a 13/14 or 14/13 split of the 27 compliers between the two groups. To facilitate follow up questions we will use 14/13 split.

    a. 2x2 table

	Robot touch	No robot touch	Total
Student complied	14	13	27
Student didn't comply	7	8	15
Total	21	21	42

    b. Proportion who complied in the treatment group: 14/21 = 0.667
    Proportion who complied in the control group: 13/21 = 0.619
    Difference in conditional proportions (treatment – control): 0.667 – 0.619 = 0.048

31. Smaller
32. p-value: larger, strength of evidence: weaker. A smaller difference in proportions is closer the zero, the center of the null distribution, so the p-value (proportion of simulated statistics as extreme) will be larger, larger p-values offer weaker evidence against the null.
33. Approximate p-value = 0.5027, this p-value provides weak evidence against the null and w can conclude it is plausible that robot touch does not increase compliance.

34. a. Same
    b. Smaller
    c. Stronger
    d. Reject null
35. The p-value ≈ 0; very strong evidence against the null at a 0.05 level of significance.
36. We now have stronger evidence that the robot touch does increase the probability of compliance, it is now very strong evidence.