

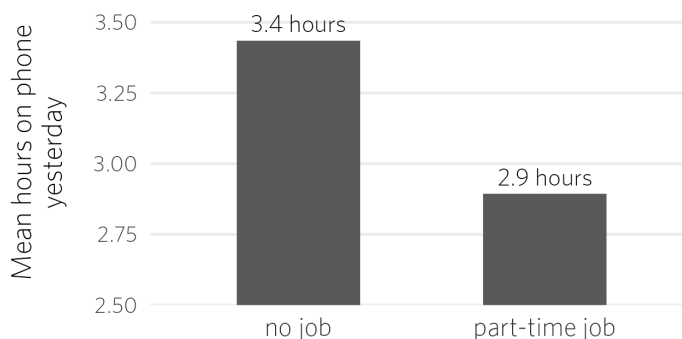
PSYCH 10 · Fall 2026 · Worksheet for Lecture 4: Explaining variation · Answer key

The answers are in blue. Where a question has more than one defensible answer, the key says so and describes what a good answer contains.

Part 1 · A bar plot in the campus paper

Students with jobs spend 15% less time on their phones

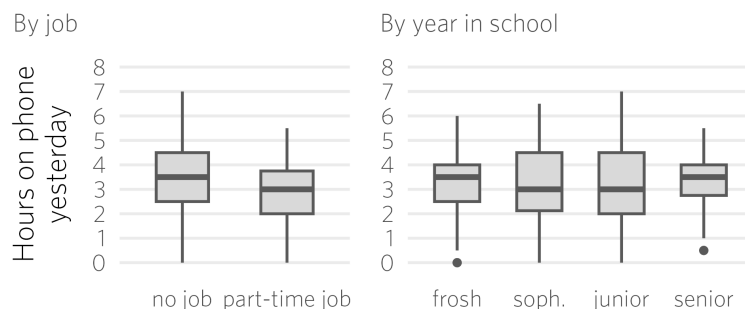
Class survey, 148 students



Suppose a campus newspaper printed this bar plot, with the headline “Students with jobs spend 15% less time on their phones.” The bars are the mean number of hours spent on the phone yesterday, for students without a job and for students with a part-time job.

- The headline says 15% less. Check that with the two numbers printed on the bars: by what percentage is the job group’s mean below the no-job group’s mean?
 - Look at where the vertical axis starts. If it started at zero instead, would the two bars look nearly the same height, or very different?
 - The two means differ by half an hour. From this bar plot alone, can you tell whether half an hour is a big difference compared with how much students *within the same group* differ from one another? What would a plot have to show before you could answer that question?
- a. With the two printed means, $(3.4 - 2.9) / 3.4 = 0.5 / 3.4 \approx 0.15$, so the headline’s 15% is an honest reading of the two numbers, and the trouble with the chart is elsewhere.
- b. Nearly the same height. From zero the bars would be 3.4 and 2.9 units tall, with the half-hour difference a sliver at the top; the chart’s axis starts at 2.5, so the visible parts of the bars are about 0.9 and 0.4 units tall, a ratio of more than two to one, for a difference that is about 15% of the larger mean.
- c. No. The chart shows two means and nothing about how the students within each group vary, so there is no way to judge from it whether half an hour is a large or a small difference. A plot would have to show the spread within each group, such as one dot per student or a box plot per group; against a within-group spread of roughly 0 to 7 hours, half an hour between the means is a small difference.

Part 2 • Job or year?



These plots show the same 148 students' phone hours broken down two ways: by job, and by year in school.

a. Which explanatory variable explains more of the variation in phone hours, job or year? Say which feature of the box plots you used: the distance between the medians, or the amount of overlap between the boxes.

b. Look at the students without a job. Is everyone in that group on their phone for about 3.5 hours a day? Say which part of the box plot is your evidence.

a. *By these plots, neither variable explains much of the variation: the medians differ by about half an hour either way (no job 3.5 against part-time 3.0; frosh and seniors 3.5 against sophomores and juniors 3.0), and the boxes overlap for most of their height. Either answer is reasonable if it names the feature it rests on, the distance between the medians or the amount of overlap between the boxes. An answer that judges one plot by its medians and the other by its overlap is using two different criteria, and the two criteria can disagree.*

b. *No. The median for the no-job group is 3.5 hours, but the box runs from about 2.5 to 4.5 hours and the whiskers reach down to 0 and up to 7, so the group includes students who barely touched their phone and students who used it for most of the day. The box and the whiskers are the evidence; the median on its own describes only the middle student.*

Part 3 • Tennis and a long life

A 2018 study followed about 8,600 adults in Copenhagen for 25 years. **People who played tennis lived about 9.7 years longer, on average, than people who did no exercise.**

a. Write down **two different processes** that could have produced that difference: two different explanations for how it could have come about, not two versions of one explanation.

b. Ask a neighbor for one of theirs and write it down as your third. Then check each other's: does your neighbor's process seem plausible to you, and does yours to them?

c. Circle the one of the three you find most plausible.

d. Pick one of the others. What would you look up, or go out and measure, to tell whether it or the one you circled is what produced the difference?

a1, a2. *Two of these, or other processes of the same kind: playing tennis lengthens life (the process behind the headline); people who are already in poor health don't take up tennis, or stop playing, so the two groups were uneven from the start (the direction runs the other way); something that makes both tennis and a long life more likely, such as wealth or good health at the start of the study, or the social contact that comes with a club sport (a third variable).*

b. *Your neighbor's process, and a sentence on whether each of you found the other's plausible.*

c. *Any of the three, circled with a reason.*

d. *To tell a third variable from the headline's process: look up whether the study measured income and health at the start and compared people at the same level; compare tennis players with people who play an equally social but less strenuous game; or look for a study that assigned people to take up tennis, which is the only design that settles the direction. The Copenhagen study itself was observational, so nobody in it was assigned to tennis.*