PSY 205 Module 3 Supplement

Comparing Correlation, Ex post facto, and Experimental Approaches to Research

As you have seen in this module, there are many ways to do research in psychology. Now let's carefully compare three common approaches to answering the same research question and review their advantages and disadvantages. We'll look at a correlational approach, an ex post facto study, and an experimental approach.   Remember Alexis' research question "Does caffeine enhance mental performance?" Let's see how we could attempt to answer this question with each of these approaches.

Let's start with the experimental approach as this is the approach that is taken when we want to determine a cause and effect relationship between two variables and it is also the approach we used when we reviewed the scientific method as a process.

Your text definition of an experiment is "Objective observation of phenomena that are made to occur in a strictly controlled situation in which one or more factors are varied and the others are kept constant." Another way to say this is to say: in an experiment the researcher manipulates (i.e., varies) one variable, controls all other variables, and then measures the effect.

Below you will see a sketch of a very basic experiment. The labels "Independent Variable" and "Dependent Variable" on the sketch anticipate some vocabulary from Module 4, but it won't hurt to introduce these important concepts here. Indeed, this is actually a review from your introductory psychology course.

Independent Variable   Dependent Variable

Presence or Absence   Scores on Practice Quiz
of Caffeine

                    Caffeine   Scores

R   Compare

                    No Caffeine   Scores

In the sketch you first see the term "Independent Variable." This is the variable manipulated by

the researcher. Thus, you can see that Alexis has manipulated the presence versus the absence

of caffeine. The term "Dependent Variable" is next. This is the variable that measures the

influence of the independent variable. It is the participant's response, or in this case, the

scores on the practice quiz.   In an experiment we manipulate the independent variable and

measure the dependent variable. We have manipulated the presence or absence of caffeine

and measured the resulting score on the practice quiz.

 Off to the left side of the sketch you see the letter R with arrows pointing to the Caffeine and

No Caffeine conditions of the independent variable. The "R" stands for random assignment;

the participants in the experiment are randomly assigned to either the caffeine group or the no

caffeine group.   Random assignment is a very powerful technique. If we randomly assign

participants to the groups, we will have equated them on all known and unknown variables.

Look carefully at the research design sketch again. Can you see what we have done? We have

randomly assigned participants to two groups. At this point in the experiment they can be

thought of as being equal on all known and unknown variables. Then we treat the two groups differently. One group gets caffeine and the other does not. Next, we measure the resulting practice quiz scores for each group and compare the scores. If the quiz scores of the caffeine group are higher than those of the no caffeine group, there is only one conclusion we can draw: the caffeine caused the higher scores.

So there we have it. With this experimental design "objective observation" occurs when we carefully calculate the practice quiz scores. The "phenomena that are made to occur" is our manipulation of caffeine and no caffeine. And we have done this "in a strictly controlled situation in which one or more factors are varied and the others are kept constant." That is, we have equated the two groups on all known and unknown variables and then, using the rule of one variable, we have manipulated the presence or absence of caffeine. Put more simply: we have manipulated the independent variable, controlled (kept constant) all other variables and measured the dependent variable.

How can we display the results of an experiment? This is done with a graph that looks like the one in this slide. Let's note some things about this graph.
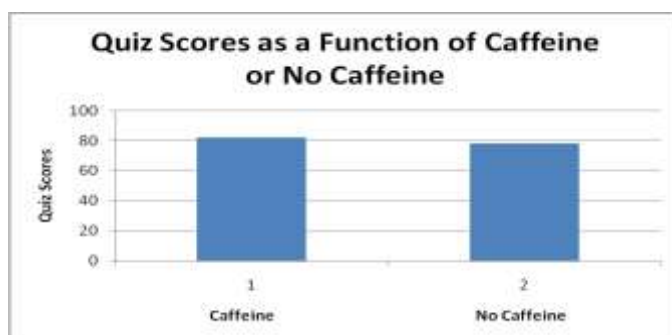
First of all – it is clearly labeled. You see the practice quiz scores on the Y axis and the caffeine and no caffeine groups on the X axis. The title of the graph would be: Quiz scores as a function of presence or absence of caffeine. The data that are shown indicate the average quiz scores for each group. So in our graph, the caffeine group (with an average quiz score of 82) did have higher scores than the no caffeine group (with an average score of 78).

A second approach Alexis could have taken for her study is the ex post facto approach. This approach is used when the variable of interest is not manipulated, but is chosen after the fact. The groups which will be compared in the study are based on individual differences on which the participants naturally differ. Thus, in our example we might simply ask individuals if they have consumed caffeine in the last four hours and if they answer in the affirmative, we will place them in the caffeine group. Those who indicate that they have not consumed caffeine in the last four hours will be placed in the no caffeine group. The participants will have assigned themselves to the groups based on their own past behavior. W e will again compare the quiz scores for the two groups.

Once again the research design is sketched below.

"Independent Variable"   "Dependent Variable"

Consumed or Did Not Consume   Practice Quiz Scores

Caffeine in Previous Four Hours

             Caffeine   Scores

                                                  Compare
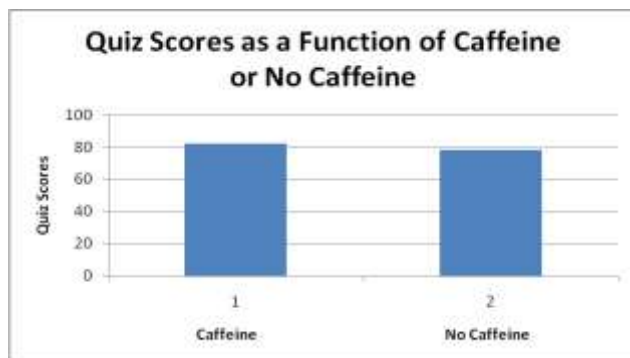
             No Caffeine   Scores

You will notice that this design looks a lot like the experimental design! Note the differences, however. First, you see that there is no R on the left hand side of the sketch to designate random assignment. The groups were not randomly assigned to the groups, they self assigned themselves to the groups based on having come to the research situation having had or not had caffeine. Also note that the "Independent Variable" and "Dependent Variable" labels have quotation marks around them. This is to indicate that while they "act like" independent and dependent variables, they are not a true independent variable or dependent variable. That is, nothing was manipulated by the researcher (hence there is no IV) and thus the quiz scores are not the result of a independent variable manipulation (hence there is no DV).

There is a great advantage to this design. It can be used to compare groups on many important traits (such as anxiety level), characteristics (such as ethnic groups), and experiences (such as having experienced a hurricane or not).   We could not randomly assign people to experience a hurricane or not, but we can compare people who have or have not had this experience.

The great disadvantage of this approach is that it cannot be used to determine cause and effect. Take a look at our two groups again – the caffeine group and the no caffeine group. Might people who regularly use caffeine be different in other ways from those who do not regularly use caffeine? For example, the participants who do not use caffeine may also pay a great deal of attention to their health so that they eat only healthy foods, get regular exercise, and get enough sleep. Thus, they may be different from regular caffeine users on a number of other variables! Thus our two groups may not be equal at the beginning of the study. When

we compare the quiz scores, then, we will not know if any difference we see in them is due to the presence or absence of caffeine or to some other variable that differentiates the two groups (such as general level of health).

How can we display the results of an ex post facto study? This is done with a graph that looks like the one in this slide. Let's note some things about this graph.

First of all –you can see that it looks just like the graph for the experimental study!

It is clearly labeled. Once again you see the practice quiz scores on the Y axis and the caffeine and no caffeine groups on the X axis. The title of the graph would again be: Quiz scores as a function of presence or absence of caffeine. The data that are shown indicate the average quiz scores for each group. So in our graph, the caffeine group (with an average quiz score of 81) did not have higher scores than the no caffeine group (with an average score of 80). (These scores are too close to be considered truly different. But that's topic for PSY 305 – Research Methods II.)

These are the results for an ex post facto study, however, and you must remember that you cannot draw a cause and effect conclusion from them.

In a correlational study the researcher measures two variables and then determines the degree of relationship between them. Our two variables would be amount of caffeine ingested during the past six hours and the score on a practice quiz. Thus, as participants entered the study, we would ask them to indicate how many cups of coffee or how many cans of cola they had consumed during the last six hours. We would then calculate their scores on the practice quiz.

Note that there is no independent or dependent variable here. We have simply measured two variables: the amount of caffeine consumed by each participant and his or her score on the practice quiz.

A positive (or direct) relationship between the two variables would be found if we find that as the amount of caffeine increases, the quiz scores also increase. A negative (or indirect) relationship would be found if we find that as the amount of caffeine increases, the quiz scores decrease. Finally, no correlation would be found if the amount of caffeine has no bearing on the quiz scores. (In Module 6 you will learn how to calculate a correlation statistic which will tell you which of the above situations your data indicate.)

Correlational data is helpful because it allows us to accomplish the goal of prediction. If there is a positive correlation between the amount of caffeine consumed and the scores on the quiz, then we could determine the amount of caffeine a person has consumed and predict his or her score on the quiz.

The great advantage to correlational studies is that they are very applicable to the real world. In our example, we could simply measure the amount of caffeine the participant consumed as

part of their regular lifestyle and then measure the quiz scores from a quiz they would have taken as part of the class they were taking.

The disadvantage to correlational studies is that they do not allow us to draw a cause and effect conclusion. A third variable may have caused our participants to consume more caffeine and to earn higher exam scores. The studying might have caused both! Our participants might have sat down to study consumed coffee while they did so and the studying would have increased their scores on the quiz!

The results of a correlational study are shown in a special graph called a scatterplot.

In a scatterplot we plot each set of scores on a separate axis. Thus, each data point on the scatterplot represents one person's two scores. Thus, for participant 1, a data point is placed over the X axis at 3 (cups of coffee or cans of caffeine) and on the Y axis at the score of 75

This slide shows the resulting scatterplot for our data. As you can see, as the amount of caffeine increases, the quiz scores also increase. We have found a positive (or direct) relationship between the amount of caffeine and practice quiz scores.
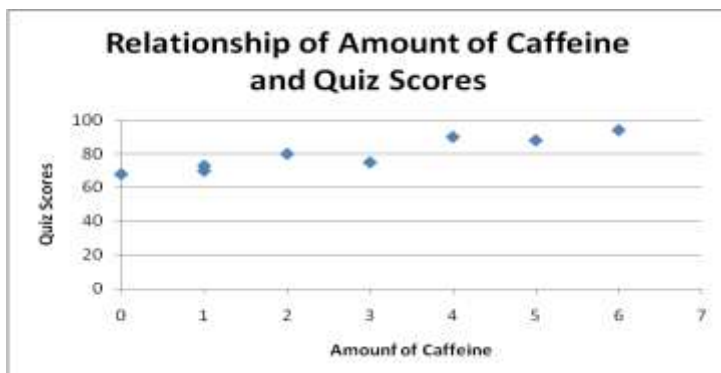
Now let's practice. For each example below, identify whether the described research is a correlational study, an ex post facto study, or an experiment.

Example 1

Dr. Ramirez is interested in the effects of playing violent video games on the aggression of young children ages 6 to 8. He asks parents to indicate the amount of time their sons play specific video games on a list he provides and categorizes those who play violent video games for more than two hours a week as boys who are exposed to high levels of violence on video games. Those who play less than two hours per week are categorized as boys who are not exposed to high levels of violence on video games. He then administers a paper and pencil interpersonal skills test which produces a score indicating a tendency to react with aggression in social situations involving conflict to the boys in his study.

What research approach did Dr. Ramirez use?

Did you identify Dr. Ramirez's study as an ex post facto study? Note how he compared the aggression scores of the two groups of boys who came to the study as either boys who were exposed to high levels of violence on video games or not. Remember that while this study allowed Dr. Ramirez to compare boys in terms of their individual differences, it does not allow him to conclude that exposure to violence in video games causes higher aggression scores. Why not? Can you suggest other ways that these two groups of boys may have differed that could have caused the difference in aggression scores?

Example 2

Dr. Quincy is interested in the effects of playing violent video games on the aggression of young children ages 6 to 8. He asks parents to indicate the amount of time their sons play specific video games on a list he provides and he calculates the total number of minutes each boy plays violent video games each week. He also calculated an aggression score for each boy in his study (by administering a paper and pencil interpersonal skills test which produces a score indicating a tendency to react with aggression in social situations involving conflict). Next he did a statistical procedure to find the relationship between the two variables.

What research approach did Dr. Quincy use?

Dr. Quincy used the correlational approach. Note how he measured two variables (amount of time playing violent video games and aggression scores). His results would show a fairly high correlation, but remember that a correlation does not allow him to draw a cause and effect conclusion. A third variable may have been the cause of both the number of minutes of playing violent video games per week and the aggression scores.

Example 3

Dr. Lovelace is interested in the effects of playing violent video games on the aggression of young children ages 6 to 8. He randomly assigned children to either play a violent video game for an hour or to play a nonviolent video game for one hour. Later that day research assistants observe the children on the play ground and count the number of aggressive behaviors they exhibit.

What research approach did Dr. Lovelace use?

Dr. Lovelace used the experimental approach. She randomly assigned the children to play the violent video game or a nonviolent video game.

What is the strength of this approach? If the data do show that the children who played the violent video game did have higher aggression scores, Dr. Lovelace may conclude that playing the violent video game caused the higher aggression scores.