07 Quantitative Research Types

1.1 The Quantitative Research Matrix

Reproduced below is a table found in course notes entitled "Quantitative Research Matrix." Note that the focus of this table is on studies that attempt to examine relations among variables. Descriptive studies do not appear in this table because they rarely focus on relations among variables, and they tend not to test hypotheses of variable relations. Instead, they usually describe the status of a population by certain characteristics such as sex, race, age, etc.

As an example of a descriptive study, see the work by Clark et a. (2010). Note that links to cited studies in this presentation are provided on the course web page directly below this presentation document.

Clark, C. M., Otterness, N. S., Jun, W. Y., Allerton, B. W., Juan, C. M., Black, M., & Wei, F. (2010). Descriptive study of student incivility in the People's Republic of China. *Journal of Cultural Diversity*, *17*(4).

Returning to the table, note there are three factors that distinguish quantitative research that attempts to examine relations among variables:

- use of randomly formed groups – true experimental only
- manipulation of the IV – experimental only, both true and quasi
- and scaling of the IV in correlational studies – categorical vs quantitative variables.

Distinguishing Characteristics	***Research Method Classification***			
	True Experimental	**Quasi-Experimental**	**Ex Post Facto (Causal Comparative)**	**Correlational**
Randomly Formed Groups	Yes	No	maybe, through random sampling	maybe through random sampling
Manipulation of Independent Variable	Yes	Yes	No	No
Group Comparisons	Usually Yes	Usually Yes	Yes	No
Causal Relationships	Can Establish	Only Identify	Only Identify	Only Identify

The last factor tends to play no useful role since most research that examines variable relations without manipulation, i.e. both correlational and ex post facto, are generally referred to as correlational studies. The use of the terms ex post facto and causal comparative was an attempt to separate naturally occurring experiments from researcher-controlled experiments, although the utility of this distinction is uncertain.

Naturally Occurring Experiment Example

> Asking 20 teaches whether they used mathematics textbook A vs textbook B then comparing student achievement at the end of the semester.

Researcher-controlled Experiment Example

> A researcher assigns mathematics textbook A to 10 randomly selected teachers and textbook B to the 10 remaining teachers and then compares student achievement at the end of the semester.

1.2 Review of The Matrix

Question

What is the only difference between true experimental and quasi-experimental research?

Answer

True uses randomly formed groups. Quasi uses groups that were formed prior to the arrival of the experimenter.

Question

What is the only difference between quasi-experimental and ex post facto?

Answer

With quasi (like true experimental), there is manipulation, but with ex post facto, which means after the fact, there is no manipulation of the IV.

Question

What is the only difference between ex post facto and correlational?

Answer

No group comparisons in correlational research.

Question

What is the scale of measurement for the primary independent variable in ex post facto research? Note that ex post facto is defined as group comparisons on some DV, so if there are groups to be compared, what is the scale of measurement for the IV?

Answer

For ex post facto, the IV is qualitative -- **nominal**. For example, we might compare boys to girls on test scores. The IV is sex, which is qualitative. For correlational research, the IV is quantitative -- which means it could be ordinal, interval, or ratio.

Question

What is the scale of measurement for the primary (manipulated) independent variable in quasi-experimental research?

Answer

With both quasi-experimental and true experimental, the manipulated IV is generally nominal (qualitative) -- group comparisons exist in both quasi- and true-experimental research. Some exceptions to this are possible, however. I will provide an example later.

Question

What is the key difference between experimental research (quasi and true) and all other forms of research?

Answer

Only difference between experimental research and all other forms of research is manipulation of the IV (note that quasi experimental research does NOT have randomly formed groups).

Question

What does it mean to manipulate an IV?

Answer

Manipulation is like politics. Politics is simply defined as "who gets what." So the researcher plays politics with the independent variable (the treatment and control conditions); the researcher decides which groups get which treatment and control conditions. That is manipulation.

1.3 Determining Types of Research

Identify the following research scenarios as true, quasi, ex post facto, or correlational.

Scenario 1

A researcher surveys students and asks them to place themselves into one of three categories: brains, smokers, popular kids (these were three categories in my wife's high school). The researcher then collected their SAT scores to see if there were differences among these three groups.

Which type of quantitative study is this?

Answer

It is ex post facto.
It is not true or quasi because there is no manipulation of the IV.
It is not correlational because there is no group comparison in correlational research.

Scenario 2

Which type of research is this? High schools located in urban areas will have more college graduates than schools located in rural areas.

Answer

Ex post facto. Note that the IV in this study is location of school (with two categories, urban vs. rural). The IV is qualitative. Since location of school cannot be manipulated by the researcher, this is an ex post facto study.

If you are having trouble with these first two examples, then try these steps to identify the type of research.

Step 1.

Identify the independent variable. If the IV is qualitative, then you can most likely rule out correlational.

Step 2.

If this IV is qualitative, then you must look to determine if it was manipulated. If it was, then that rules out ex post facto research.

Step 3.

Lastly, one determines if the groups of the IV were randomly formed. If they were, then you have true experimental, if not, then you have quasi-experimental.

Scenario 3

There is an association between the number of older siblings and the social maturity scores (these scores come from a scale administer to each child, and the scale ranges from 1=low to 37=high) of six-year-old children.

Answer

Correlational, all variables are quantitative, and there is no manipulation, so correlational

Scenario 4

A researcher wishes to investigate whether reciprocal peer tutoring (RPT) affects academic self-efficacy among graduate students. The researcher randomly assigns the RPT treatment to his morning class, while the afternoon class does not use RPT. To assure that students are exposed to the same classroom environment (except for RPT), the researcher uses identical class notes, lectures, examples, exams, etc. in both classes; the only difference between the two classes is RPT. The researcher need not worry that students will become concerned about the RPT difference between their classes since both classes are taught in different locations. At the end of the quarter the researcher administers an instrument designed to measure academic self-efficacy. He finds no difference in academic self-efficacy between the two classes.

Answer

Since the IV was manipulated, we know this example is either quasi or true. The researcher used intact classes, so this is quasi-experimental.

Scenario 5

A researcher is interested in learning whether a relationship exists between academic self-efficacy (the level of confidence one expresses in their academic ability) and students' self-ranking on an attribution instrument. The academic self-efficacy scale provides scores that range from 1=low self-efficacy to 50=high self-efficacy. Also, the self-ranking ranges from 10=low to 25=high.

Answer

Both variables are quantitative -- no group comparisons, and no manipulation of the IV, so this will be correlational.

Scenario 6

The Times, London, April 6, 2004. No child under the age of two should be allowed to watch TV because of the risks of developing attention deficit disorders, according to scientists. Parents who put young children in front of the TV are leaving them prone to concentration problems, impulsiveness and restlessness by school age, research suggests. A study conducted by scientists in America found that for every hour of TV watched daily, toddlers faced a 10 per cent increased risk of having attention problems by the age of seven. While children under two should watch no television at all, older children should be allowed to watch no more than two hours a day, the scientists concluded. Dr Dimitri Christakis, the report's author, said findings had shown that children could become mesmerised by the TV screen, which appeared to affect the development of the brain. Dr Christakis, of the Childrens Hospital and Regional Medical Centre in Seattle, said: The truth is there are lots of

reasons for children not to watch TV. The newborn brain develops very rapidly during the first two to three years of life. Its really being wired. We know from studies of newborn rats that if you expose them to different levels of visual stimuli, the architecture of the brain looks very different. The study, in the April issue of the US journal Pediatrics, involved 1,345 children. Parents were questioned about their childrens viewing (average hours per day) and asked to rate their behaviour at the age of seven on a scale like the one used to diagnose attention deficit disorders. The youngsters who watched the most TV were more likely to rank within the top 10 per cent for concentration problems, impulsiveness, restlessness and being easily confused.

Answer

The IV is average hours per day watching TV (quan), and the DV is rating on scale, also quan. The IV was not manipulated, so this is correlational.

Scenario 7

A researcher is interested in how students interpret and respond to feedback in class on their academic performance (e.g., teacher's comments, graded tests, papers). The researcher chooses to use "attribution theory" to guide the research. Essentially this theory specifies that each student has an attributional tendency that governs the way in which he will respond in feedback situations. That is, one student may attribute his B grade to his having studied carefully, another to his good fortune, and a third may conclude that the teacher likes him. The researcher wants to know whether giving all students consistently high grades will change their attributional patterns. A random sample of 50 students is drawn from a local middle school. Half are assigned, in a random fashion, to a treatment condition where the teacher has agreed to give them high grades regardless of their performance, and the other half are graded in a usual manner. The researcher sends a graduate assistant to the various schools to administer his attribution instrument (25 statements regarding feelings toward evaluation that students are to rate on a 5-point Likert scale) before and again after the study is completed. Which type of research is this?

Answer

True experimental since the IV was manipulated and groups were randomly formed.

Scenario 8

Do differing levels of reading practice time influence reading achievement? Students in 15 second grade classes participated. Each class was randomly assigned to differing amounts of reading practice time ranging from 5 minutes per day to 50 minutes in increments of 3 minutes. Thus, in one classroom all students read 5 minutes, in the next all read 8 minutes, in the next all read 11 minutes, etc. up to 50 minutes. At the end of the semester, all students were administered a reading achievement test and scores collected. Researchers found that as practice time increased, so did achievement.

Answer

Quasi-experimental. This one is somewhat difficult because it combines elements from two types, it has an IV that is quantitative, and it has manipulation. Note that the IV is quantitative, practice reading time in minutes. However, this variable was manipulated, so this is not a correlational study. It is not true experimental since whole classes were used, thus groups were not randomly formed as required in true experimental; instead, the treatments were randomly assigned to intact, whole groups (classes). To be true experimental, treatment and individual participants must be randomly formed in some way.

Scenario 9

A researcher is interested in learning whether cooperative learning affects students' academic self-efficacy. At the beginning of the quarter the researcher randomly decides that class A will employ cooperative learning and class B will not. On the first night of both classes the researcher administers to all students in each class a questionnaire that is designed to measure self-efficacy. Throughout the quarter class A works in cooperative learning groups and class B does not. At the end of the quarter the researcher re-administers the self-efficacy questionnaire to determine whether there was a change in self-efficacy. Later, during the data analysis stage the researcher notes three things: (1) the internal consistency of the self-efficacy questionnaire is .34, (2) the self-efficacy scores show about a 25% increase for class A and a 17% for class B, and (3) the initial differences between the two classes on self-efficacy was substantial with class A showing roughly 30% higher scores on self-efficacy. Which type of research is this?

Answer

Quasi experimental; intact groups used and IV was manipulated by the researcher (he randomly decided which class would use cooperative learning).

Which type of statistical analysis should be used here?

Answer

This sentence plays a key role in deciding statistical analyses: "On the first night of both classes the researcher administers to all students in each class a questionnaire that is designed to measure self-efficacy."

Since a premeasure was used, and since the primary IV represents groups to compare (class A vs B, use of cooperative learning vs. no cooperative learning), ANCOVA would be appropriate. The premeasure would serve as the covariate so the researcher could make adjustments on the DV (self-efficacy) for initial difference among groups on self-efficacy. So ANCOVA would be best since it allows the researcher to equate groups on initial levels of self-efficacy.

What does the information in this example tell you about the reliability of the self-efficacy measure, and is the reliability strong or weak?

Answer

The internal consistency of the questionnaire is .34; Normally we want to see reliability above .7, sometimes .6 is acceptable, but a value of .34 is no good.

What does this tell us about validity?

Answer

Scores will be invalid with such low reliability.

1.4 Random Sampling, Random Assignment, and Randomly Formed Groups

Occasionally students are confused by random sampling, random assignment, and randomly formed groups. Sometimes the concepts overlap, and sometimes they don't. To decide if a true experiment exists, you must seek to determine if treatments were manipulated and if groups were randomly formed by the researcher. This can occur in several ways. Here are a few examples:

1. From a list of 100 students, 15 were randomly selected for treatment A, and 15 more were randomly selected for treatment B. In this example the use of random selection satisfies the requirement of randomly formed groups so a true experiment can result.

2. Note that not all randomly selected groups result in a true experiment. For example, 15 black females were randomly selected to ask their opinions about medications, and 15 white females were randomly selected and asked the same thing. This is not a true experiment because nothing was manipulated. The point of these two examples is to demonstrate when random selection (i.e., random sampling) can form random groups for a true experiment, and when it does not make a true experiment.

3. Treatments A and B were randomly assigned to either Mrs. Smith's class or Mrs. Jones' class. In this example, intact groups are used, so this is not a true experiment. Despite the use of randomly assigned treatments, this is not a true experiment due to lack of randomly formed groups.

4. Mrs. Brown has three classes of algebra 1. Students in Mrs. Brown's first class were randomly assigned to one of three texts, text A, B, or C, thus three groups were formed in the first class, one for each text. Similarly, students in Mrs. Brown's second class were also randomly assigned to use each of the three texts. This same process was repeated for students in the third class. Note that there is no random sampling in this example. However, students in each class were randomly divided into three groups and each group used a different text. So, in the first class, there are three groups of students; some students use text A, some use text B, and some use text C. This is an example of a true experiment because the groups were randomly formed.

As you can see from the above, the requirements for a true experiment can be satisfied in different ways, sometimes random sampling can lead to randomly formed groups suitable for a true experiment and sometimes random sampling does not lead to a true experiment. Similarly, the lack of random sampling does not preclude a true experiment either as example #4 above shows. Different situations can arise in which random sampling (i.e., random selection), random assignment, and randomly formed groups can exist, sometimes to create true experiments, sometime maybe not. The key is that you must identify two things: (a) is there manipulation of the IV by the researcher, and (b) were the groups randomly formed. If the answer is yes to both, then you have a true experiment.

1.5 Examples with Published Studies
Each publication is linked on the course web page directly below this presentation document.

True Experimental
Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education*, *33*, 86-92.

- design used was the pretest-posttest exp and control groups
- "The experimental and control groups are randomly distributed…" phrasing not clear, but reads like treatments randomly assigned to groups p 87, but see section 2.1 on p 87
- "Participants were randomly assigned to experimental…." they stratified random assignment on sex

Sirakaya, M., & Kilic Cakmak, E. (2018). Effects of augmented reality on student achievement and self-efficacy in vocational education and training. *International journal for research in vocational education and training*, *5*(1), 1-18.

- claimed quasi-experimental in abstract and method
- matched students for control purposes (eliminate possible confounding variables) p 7
- sampled pairs matched on pre-test results then randomly assigned to exp and control group, thus this a true experimental study p 7

Quasi-Experimental

Saputro, A. D., Atun, S., Wilujeng, I., Ariyanto, A., & Arifin, S. (2020). Enhancing Pre-Service Elementary Teachers' Self-Efficacy and Critical Thinking Using Problem-Based Learning. *European Journal of Educational Research*, *9*(2), 765-773.

- announced correctly quasi-experimental, classes randomly assigned
- table shows study design
- correctly labeled design as nonequivalent pretest-posttest control group
- checked pretest scores for group equivalence

Lybarger, J. E., Rancer, A. S., & Lin, Y. (2017). Superior–subordinate communication in the workplace: Verbal aggression, nonverbal immediacy, and their joint effects on perceived superior credibility. *Communication Research Reports*, *34*(2), 124-133.

- did not announce type, quasi or true, in abstract or method
- abstract description p 124 "Participants … from intact classes were randomly assigned…." so this can be interpreted as individuals were random assigned suggesting true experimental study
- but explained p 127 that intact classes were randomly assigned to exp or control

True/Quasi mix

Muratori, P., Bertacchi, I., Giuli, C., Nocentini, A., & Lochman, J. E. (2017). Implementing Coping Power adapted as a universal prevention program in Italian primary schools: A randomized control trial. *Prevention science*, *18*(7), 754-761.

- Abstract: 40 classes randomly assigned to exp or control p 745
- Participants: intact classes randomly assigned to intervention or control groups p 757
- large number of classes and students, this design has mixture of both quasi and true features due to large number of classes (n = 40) participating, and number of students n = 901
- note they did not provide a label as true or quasi, only that it was experimental

Ex Post Facto

Mattox, K., Hancock, D. R., & Queen, J. A. (2005). The effect of block scheduling on middle school students' mathematics achievement. *NASSP Bulletin*, *89*(642), 3-13.

- unlike true and quasi studies, no study design identified
- first paragraph uses word experimenting, but this does not suggest this study is experimental
- 5 middle schools sampled for 6 academic years
- traditional schedules first 3 years
- block schedules next 3 years
- Non-block vs Block (primary IV of interest)
- also, IV school comparison (a b c d and e; secondary IV, of lesser interest for study)

Selkie, E. M., Kota, R., Chan, Y. F., & Moreno, M. (2015). Cyberbullying, depression, and problem alcohol use in female college students: a multisite study. *Cyberpsychology, Behavior, and Social Networking*, *18*(2), 79-86.

- survey, groups formed based upon self-reported experiences
- two DVs compared across groups, depression and problematic alcohol use (see Table 3 p 83)

Correlational

Michinov, N. (2005). Social comparison, perceived control, and occupational burnout. *Applied Psychology*, *54*(1), 99-118.

- uses phrase experimental population in study 2, but this is not description of study design
- contains no grouping variables that were compared
- all variables quantitative
- method of analysis was Pearson correlation and regression, common for correlational studies