EXPERIMENTAL RESEARCH DESIGNS

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Experimental research is any research conducted with a scientific approach, where a set of variables are kept constant while the other set of variables are being measured as the subject of experiment. There are times when you don't have enough data to support your decisions. In such situations, you need to carry out experiments to discover the facts. Experimental research can gather a lot of data that can help you make better decisions.

The simplest example of an experimental research is conducting a laboratory test. As long as research is being conducted under scientifically acceptable conditions – it qualifies as an experimental research. A true experimental research is considered to be successful only when the researcher confirms that a change in the dependent variable is solely due to the manipulation of the independent variable.

Experimental research should establish a cause and effect of a phenomenon, i.e. effects are observed from an experiment due to the cause. As naturally, occurring event can be confusing for researchers to establish conclusions.

Experimental research is conducted in the following situations:

- Time is a vital factor for establishing a relationship between cause and effect.
- Constant behaviour between cause and effect.
- The eminence of cause-effect relationship is as per desirability.

Types of Experimental Research Design

There are three primary types of experimental research design:

- Pre-experimental research design
- True experimental research design
- Quasi-experimental research design

The different types of experimental research design are based on the how the researcher classifies the subjects according to various conditions and groups.

1. **Pre-Experimental Research Design**: This is the simplest form of experimental research design. A group, or various groups, are kept under observation after factors are considered for cause and effect. It is usually conducted to understand whether further investigation needs to be carried out on the target group/s, due to which it is considered to be cost-effective.

The pre-experimental research design is further bifurcated into three types:

- One-shot Case Study Research Design:

One-shot case studies is the design where, One group is exposed to the treatment, and only a post-test is given to observe or measure the effect of the treatment on the dependent variable within the experimental group.
In this arrangement, subjects are presented with some type of treatment, such as a semester of college work experience, and then the outcome measure is applied, such as college grades. Like all experimental designs, the goal is to determine if the treatment had any effect on the outcome.

One Shot Case Study is an attempt to explain a consequence by an antecedent.

As explained above, the chosen group is exposed to the treatment, and then it is tested only once for the purpose of measuring the degree of change on the dependent variable after the treatment.

- One-group Pretest-posttest Research Design

In a one-group pretest-posttest design, the dependent variable is measured once before the treatment is implemented and once after it is implemented. Let's return to the example of a researcher who is interested in the effectiveness of an anti-drug education program on elementary school students' attitudes toward illegal drugs. The researcher could measure the attitudes of students at a particular elementary school during one week, implement the anti-drug program during the next week, and finally, measure their attitudes again the following week. The pretest-posttest design is much like a within-subjects experiment in which each participant is tested first under the control condition and then under the treatment condition. It is unlike a within-subjects experiment, however, in that the order of conditions is not counterbalanced because it typically is not possible for a participant to be tested in the treatment condition first and then in an "untreated" control condition.

You might notice that the pretest-posttest design is much like a within-subjects experiment in which each participant is tested first under the control condition and then under the treatment condition. It is unlike a within-subjects experiment, however, in that the order of conditions is not counterbalanced because it typically is not possible for a participant to be tested in the treatment condition first and then in an "untreated" control condition.

If the average posttest score is better than the average pretest score (e.g., attitudes toward illegal drugs are more negative after the anti-drug educational program), then it makes sense to conclude that the treatment might be responsible for the improvement. Unfortunately, one often cannot conclude this with a high degree of certainty because there may be other explanations for why the posttest scores may have changed. One category of alternative explanations goes under the name of history. Other things might have happened between the pretest and the posttest that caused a change from pretest to posttest. Perhaps an anti-drug program aired on

television and many of the students watched it, or perhaps a celebrity died of a drug overdose and many of the students heard about it.

Another category of alternative explanations goes under the name of maturation. Participants might have changed between the pretest and the posttest in ways that they were going to anyway because they are growing and learning. If it were a year long anti-drug program, participants might become less impulsive or better reasoners and this might be responsible for the change in their attitudes toward illegal drugs.

Another threat to the internal validity of one-group pretest-post test designs is testing which refers to when the act of measuring the dependent variable during the pre-test affects participants' responses at post-test. For instance, completing the measure of attitudes towards illegal drugs may have had an effect on those attitudes. Simply completing this measure may have inspired further thinking and conversations about illegal drugs that then produced a change in post-test scores.

Similarly, instrumentation can be a threat to the internal validity of studies using this design. Instrumentation refers to when the basic characteristics of the measuring instrument change over time. When human observers are used to measure behavior, they may over time gain skill, become fatigued, or change the standards on which observations are based. So participants may have taken the measure of attitudes toward illegal drugs very seriously during the pretest when it was novel but then they may have become bored with the measure at posttest and been less careful in considering their responses.

Another alternative explanation for a change in the dependent variable in a pretest-posttest design is regression to the mean. This refers to the statistical fact that an individual who scores extremely on a variable on one occasion will tend to score less extremely on the next occasion. For example, a bowler with a long-term average of 150 who suddenly bowls a 220 will almost certainly score lower in the next game. Her score will "regress" toward her mean score of 150. Regression to the mean can be a problem when participants are selected for further study because of their extreme scores. Imagine, for example, that only students who scored especially high on the test of attitudes toward illegal drugs (those with extremely favorable attitudes toward drugs) were given the anti-drug program and then were retested. Regression to the mean all but guarantees that their scores will be lower at the posttest even if the training program has no effect.

A closely related concept—and an extremely important one in psychological research—is spontaneous remission. This is the tendency for many medical and psychological problems to improve over time without any form of treatment. The common cold is a good example. If one were to measure symptom severity in 100 common cold sufferers today, give them a bowl of chicken soup every day, and then measure their symptom severity again in a week, they would probably be much

improved. This does not mean that the chicken soup was responsible for the improvement, however, because they would have been much improved without any treatment at all. The same is true of many psychological problems. A group of severely depressed people today is likely to be less depressed on average in 6 months. In reviewing the results of several studies of treatments for depression, researchers Michael Posternak and Ivan Miller found that participants in waitlist control conditions improved an average of 10 to 15% before they received any treatment at all (Posternak & Miller, 2001). Thus one must generally be very cautious about inferring causality from pretest-posttest designs.

- Static-group Comparison

  A group that has experienced some treatment is compared with one that has not. Observed differences between the two groups are assumed to be a result of the treatment.

2. **True Experimental Research Design**: True experimental research is the most accurate form of experimental research design as it relies on statistical analysis to prove or disprove a hypothesis. It is the only type of Experimental Design that can establish a cause-effect relationship within a group/s. In a true experiment, there are three factors which need to be satisfied:

- Control Group (Group of participants for research that are familiar to the Experimental group but experimental research rules do not apply to them.) and Experimental Group (Research participants on whom experimental research rules do apply.)
- Variable which can be manipulated by the researcher
- Random distribution

3. **Quasi-Experimental Research Design**: The word "Quasi" indicates resemblance. A quasi-experimental research design is similar to experimental research but is not exactly that. The difference between the two is centred around the assignment of a control group. In this research design, an independent variable is manipulated but the participants of a group are not randomly assigned as per conditions. The independent variable is manipulated before calculating the dependent variable and so, directionality problem is eliminated. Quasi-experimental research is used in field settings where random assignment is either irrelevant or not required.

There are many different kinds of quasi-experiments, but we will discuss just a few of the most common ones here.

Nonequivalent Groups Design

Recall that when participants in a between-subjects experiment are randomly assigned to conditions, the resulting groups are likely to be quite similar. In fact, researchers consider them to be equivalent. When participants are not randomly assigned to conditions, however, the resulting groups are likely to be dissimilar in some ways. For this reason, researchers consider them to be nonequivalent. A nonequivalent groups design, then, is a between-subjects design in which participants have not been randomly assigned to conditions.

Imagine, for example, a researcher who wants to evaluate a new method of teaching fractions to third graders. One way would be to conduct a study with a treatment group consisting of one class of third-grade students and a control group consisting of another class of third-grade students. This design would be a nonequivalent groups design because the students are not randomly assigned to classes by the researcher, which means there could be important differences between them. For example, the parents of higher achieving or more motivated students might have been more likely to request that their children be assigned to Ms. Williams's class. Or the principal might have assigned the "troublemakers" to Mr. Jones's class because he is a stronger disciplinarian. Of course, the teachers' styles, and even the classroom environments, might be very different and might cause different levels of achievement or motivation among the students. If at the end of the study there was a difference in the two classes' knowledge of fractions, it might have been caused by the difference between the teaching methods—but it might have been caused by any of these confounding variables.

Of course, researchers using a nonequivalent groups design can take steps to ensure that their groups are as similar as possible. In the present example, the researcher could try to select two classes at the same school, where the students in the two classes have similar scores on a standardized math test and the teachers are the same sex, are close in age, and have similar teaching styles. Taking such steps would increase the internal validity of the study because it would eliminate some of the most important confounding variables. But without true random assignment of the students to conditions, there remains the possibility of other important confounding variables that the researcher was not able to control.

Pretest-Posttest Design

In a pretest-posttest design, the dependent variable is measured once before the treatment is implemented and once after it is implemented. Imagine, for example, a researcher who is interested in the effectiveness of an antidrug education program on elementary school students' attitudes toward illegal drugs. The researcher could measure the attitudes of students at a particular elementary school during one week, implement the antidrug program during the next week, and finally, measure their attitudes again the following week. The pretest-posttest design is much like a within-subjects experiment in which each participant is tested first under the control condition and then under the treatment condition. It is unlike a within-subjects experiment, however, in that the order of conditions is not counterbalanced

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Another alternative explanation for a change in the dependent variable in a pretest-posttest design is regression to the mean. This refers to the statistical fact that an individual who scores extremely on a variable on one occasion will tend to score less extremely on the next occasion. For example, a bowler with a long-term average of 150 who suddenly bowls a 220 will almost certainly score lower in the next game. Her score will "regress" toward her mean score of 150. Regression to the mean can be a problem when participants are selected for further study because of their extreme scores. Imagine, for example, that only students who scored especially low on a test of fractions are given a special training program and then retested. An extremely important one in psychological research—is spontaneous remission. This is the tendency for many medical and psychological problems to improve over time without any form of treatment. The common cold is a good example. If one were to measure symptom severity in 100 common cold sufferers today, give them a bowl of chicken soup every day, and then measure their symptom severity again in a week, they would probably be much improved. This does not mean that the chicken soup was responsible for the improvement, however, because they would have been much improved without any treatment at all. The same is true of many psychological problems. A group of severely depressed people today is likely to be less depressed on average in 6 months. In reviewing the results of several studies of treatments for depression, researchers Michael Posternak and Ivan Miller found that participants in waitlist control conditions improved an average of 10 to 15% before they received any treatment at all (Posternak & Miller, 2001).Thus one must generally be very cautious about inferring causality from pretest-posttest designs.

Interrupted Time Series Design

A variant of the pretest-posttest design is the interrupted time-series design. A time series is a set of measurements taken at intervals over a period of time. For example, a manufacturing company might measure its workers' productivity each week for a year. In an interrupted time series-design, a time series like this one is "interrupted" by a treatment. In one classic example, the treatment was the reduction of the work shifts in a factory from 10 hours to 8

hours (Cook & Campbell, 1979)[5]. Because productivity increased rather quickly after the shortening of the work shifts, and because it remained elevated for many months afterward, the researcher concluded that the shortening of the shifts caused the increase in productivity. Notice that the interrupted time-series design is like a pretest-posttest design in that it includes measurements of the dependent variable both before and after the treatment. It is unlike the pretest-posttest design, however, in that it includes multiple pretest and posttest measurements.

Combination Designs

A type of quasi-experimental design that is generally better than either the nonequivalent groups design or the pretest-posttest design is one that combines elements of both. There is a treatment group that is given a pretest, receives a treatment, and then is given a posttest. But at the same time there is a control group that is given a pretest, does not receive the treatment, and then is given a posttest. The question, then, is not simply whether participants who receive the treatment improve but whether they improve more than participants who do not receive the treatment.

Imagine, for example, that students in one school are given a pretest on their attitudes toward drugs, then are exposed to an antidrug program, and finally are given a posttest. Students in a similar school are given the pretest, not exposed to an antidrug program, and finally are given a posttest. Again, if students in the treatment condition become more negative toward drugs, this change in attitude could be an effect of the treatment, but it could also be a matter of history or maturation. If it really is an effect of the treatment, then students in the treatment condition should become more negative than students in the control condition. But if it is a matter of history (e.g., news of a celebrity drug overdose) or maturation (e.g., improved reasoning), then students in the two conditions would be likely to show similar amounts of change. This type of design does not completely eliminate the possibility of confounding variables, however. Something could occur at one of the schools but not the other (e.g., a student drug overdose), so students at the first school would be affected by it while students at the other school would not.