Hi. This tutorial covers experimental design. Now, before we start talking about how to design an experiment, it's important to have a good working definition of what an experiment is. So an experiment deliberately imposes some treatment or placebo treatment on individuals in order to observe their responses. So I've underlined deliberately imposes treatment. So that's important. We need to actually impose some treatment to see if it makes a change in our response, so the response variable.

Now, when you're running an experiment, you want to make sure that you keep these definitions in mind. So the first one is a factor. So a factor is one or more explanatory variables in an experiment.

So remember, when you're running an experiment, you're trying to show a cause and effect relationship. The explanatory variable is what you want to cause a change in the response variable so what you want to cause an effect in. That treatment is any particular combination of values for the explanatory variables. So a factor can have many treatments associated with it.

Now, an extraneous factor is a factor that is not of interest in the experiment but is thought to affect the response variable. So that's important thing here is not of interest. So if it's not of interest, really, an extraneous factor is bad. It's extraneous.

And the reason they're bad is extraneous factors that are not dealt with in the design of an experiment may become confounding variables later. So a confounding variable is a variable that affects the response variable but isn't really related to the explanatory variable. So a confounding variable confounds the explanatory variable. It lessens the effect of the explanatory variable.

Since extraneous factors are bad, there are three principles of a well-designed experiment that help eliminate extraneous factors, the first one being control, sometimes known as direct control. The next one is called randomization and third being called replication. So let's go ahead and define each of those three terms.

Control is simply just to hold extraneous factors constant. So really, just we want to eliminate them right off the bat. Hold them constant. The second, randomization-- randomization is you randomly assign groups to treatments or treatments to groups to attempt to create equivalent experimental groups.

So if there's something weird going on with some participants in a group, using randomization, we

hope that those-- that anything weird kind of gets all randomly designed-- or randomized so that you don't end up with a bunch of weird results in one group but not in the other. If you effectively randomize, hopefully that'll minimize the effect of those weird things that can pop up in an experiment.

Replication is when you replicate the experimental conditions often to ensure there are an adequate number of observations for each condition. And we'll talk more about that in a minute.

So let's talk about-- or let's take a look at a situation here and see where we can implement some of those principles of a well-designed experiment. So high cholesterol level in people can be reduced by exercise or drug treatment. A pharmaceutical company has developed a new cholesterol-reducing drug.

Researchers would like to compare its effects to the effects of the cholesterol-reducing drug that is currently available on the market. Volunteers who have a history of high cholesterol and who are currently not on medication will be recruited to participate in the study.

So before we actually do this the experiment, we want to try to identify some extraneous factors and try to limit them prior to performing the experiment. So what extraneous factors can be identified? So an extraneous factor has to have an effect on the response. So in this case, the response variable would be cholesterol level.

So the three main ones that I can think of are age. Generally, the older people get, the more variability in cholesterol they'll have. Two is gender. Generally, there are pretty significant cholesterol differences in males and females. So gender may be an extraneous factor.

And the third one is just their general exercise level. So are these people that exercise a lot? Are they people that are couch potatoes that don't get any exercise? So exercise level will have an effect on cholesterol level.

So now, what we want to look at is, how can control, randomization, and replication be used to eliminate these extraneous factors? Our goal is to try to eliminate these-- effects of these on the cholesterol level. So how can we use these three components to eliminate these extraneous factors?

So let's start with control. Control could be used to eliminate gender as an extraneous factor by only allowing female participants. So if you're worried about the effects of males versus females, if we only allow female participants, that eliminates that possible extraneous factor. So control can be used to eliminate gender.

Randomization could be used to try to eliminate age. So randomization, age. If participants are randomly assigned to either the new drug group or the old drug group, a randomization should allow for a random mix of ages in each group.

So you won't have to worry about all old people being in the new group, the new drug group, and all young people being in the old drug group. If we sufficiently randomize, that should help us limit the effects, the confounding effects, of age on the drug.

And replication could be used to try to eliminate exercise level as an extraneous factor. If the study is replicated enough, the effects of somebody who gets an extreme amount of exercise will be lessened. So if you get a few people that are those marathon runners who just exercise all the time, chances are there's not going to be a lot of them in the study.

So if we do replication and do the study enough times, those effects of those marathon runners won't have a real big adverse effect on our experiment. If there are people that get absolutely no exercise, if we replicate that enough, the effects of those will also be lessened.

So control, randomization, and replication are three key ways of designing an experiment so that extraneous factors can be either eliminated or at least their effects being lessened. So that is your tutorial on experimental design. Thanks for watching.