Marketing Research and Analysis-II (Application Oriented)
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Lecture – 13
Research Design - III

Welcome friends to the course of Marketing Research and Analysis. Thank you for participating in this course. In the last lecture, we were talking about causal research and experimentation in particular. So we all know that causal research means the cause and effect research and most of the researchers under causal is basically on the experimentation research. So when you try to experiment the effect of a variable on another variable or more than one variable on some other variable.

So whenever we try to see such kind of effects, we try to conduct it through an experiment. So today we will be continuing with the same lecture. So in the last lecture, we understood that the presence of an independent variable gives rise to the occurrence of a dependent variable that means the change in the value of the dependent variable happens due to the presence or absence of the independent variable right. So from there we continue and we understand today what are the conditions, so what conditions are required for causality.

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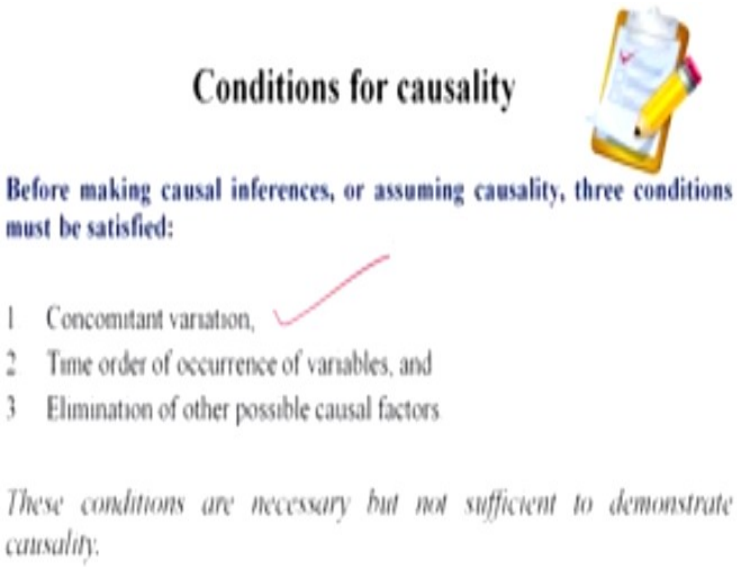

So the conditions for causality. So what are the conditions that you need to keep in mind when you talk about an experimental research or a causal research. Before making causal

inferences, we knew in the last class we discussed about concomitant variation, now what is this concomitant variation and what does it mean, let us see this.

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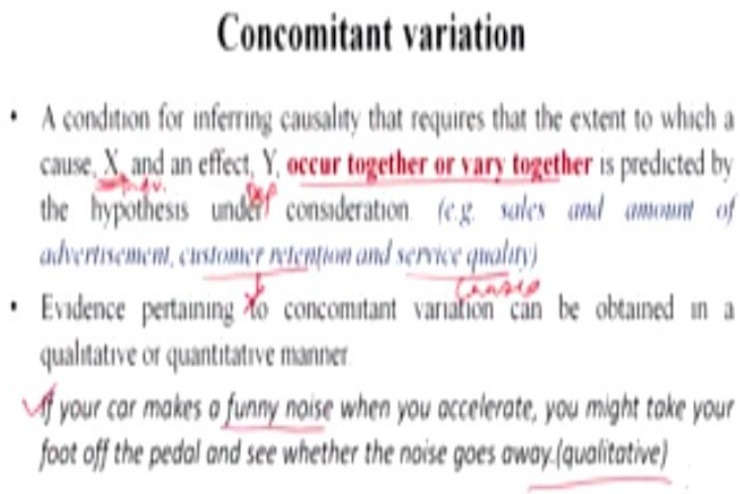

It is a condition for inferring causality that requires that the extent to which a cause X, X is the cause that is the independent variable and the effect Y which is the dependent variable occur together or vary together, that means they move simultaneously, either they happen together or they move simultaneously and it is predicted by the hypothesis under consideration. Example sales and amount of advertisement, so they vary together, though your sales which is the dependent variable varies according to the amount of the independent variable which is advertisement.

Similarly customer retention and service quality. So your service quality is now the cause which decides the customer, will it retain the customer or the customer will leave the firm. So these things happen together, that is why it is called a concomitant variation. Evidence pertaining to concomitant variation can be obtained in a qualitative or quantitative manner, so quantitatively also you can check it, you can check it qualitatively. Now for example take this.

If your car makes a funny noise, suppose you are driving a car and suddenly you find that there is a funny noise as soon as you put your foot on the accelerator. So then you try to connect whether it is due to the accelerator or some other reason. So to know that what you do you remove your foot from the accelerator to see whether the sound has remained the

same or it has decreased. So any change in the sound or no change will decide whether there is some problem with the accelerator.

So what it says is if you have a noise, you might take your foot off the pedal and see whether the noise goes away, so this is a qualitative way of understanding the concomitant variation.

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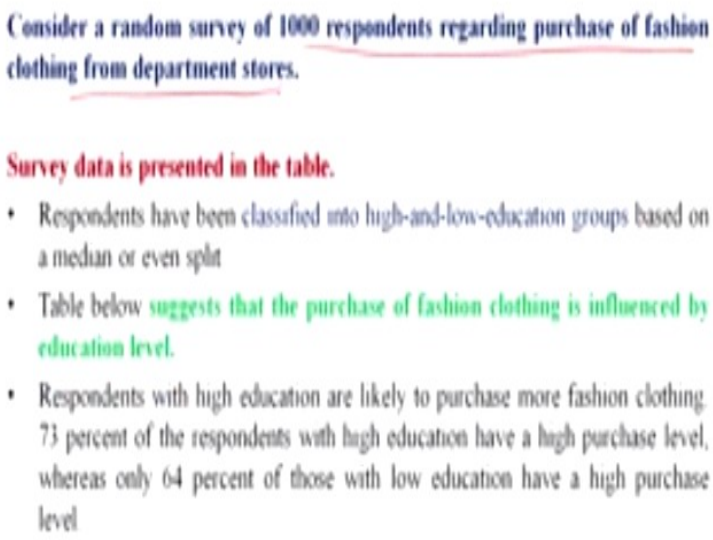

Now consider this case of 1000 respondents regarding purchase of fashion clothing from department stores. So there are 1000 people who are purchasing fashion clothing, fashion clothing are basically clothes which are very trendy clothes and they are sometimes costly too. So the survey data is presented in the next table.

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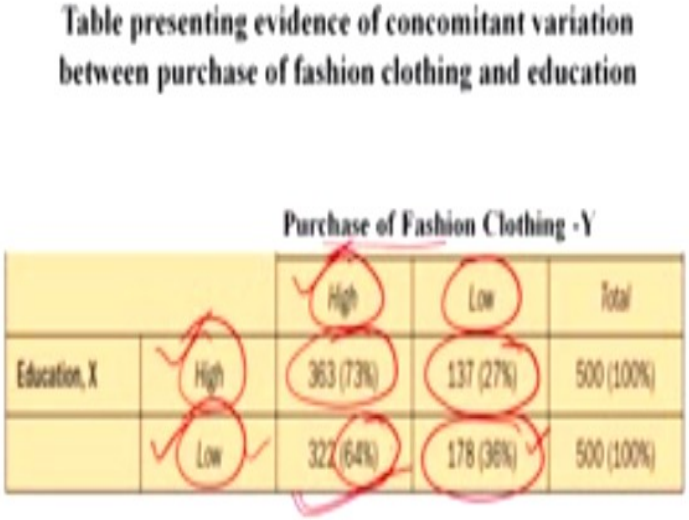

So this is the table, but before we go to that we will see this. Respondents have been classified into high and low education groups. Now you see high education and low education groups and the purchase of fashion clothing is also high and low. So there are 2 things right. It suggest that the purchase of fashion clothing is influenced by education level. So the table suggests that the purchase of fashion clothing is influenced by education level.

Now look at this, the respondents with a high education level, the purchase of fashion clothing is more 73%, only 27% percent have a low fashion clothing, purchase of fashion clothing only 27% percent, but 73% percent have a high interest for purchasing of fashion clothes. Similarly when the education is low, still you see the purchase of fashion clothing is 64% which is considerably high, but yes it is not as high as when the education is high. On the other side, the not interested or low purchase of fashion clothing is only 36%.

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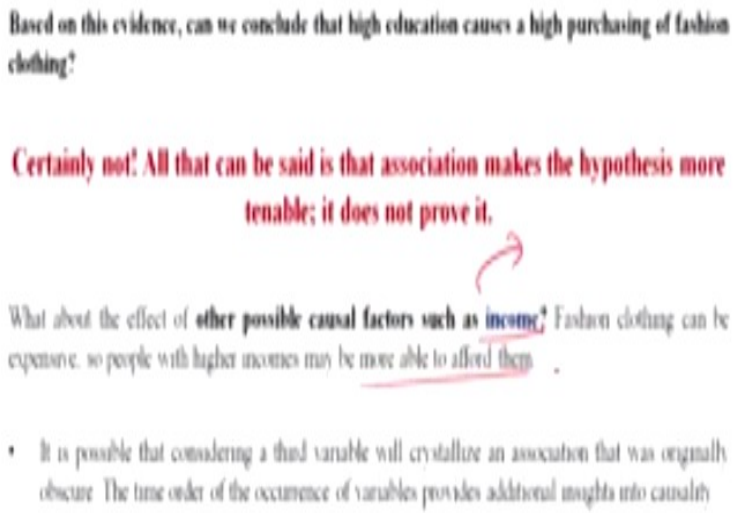

So the question here comes is based on this evidence, can you conclude that education or high education causes a high purchasing of the fashion clothing, from this table can you conclude that high education is related with high purchase, certainly not right, why? Because we have seen that people with low education also have sufficiently high interest in purchasing fashion clothes. All that can be said is that association make the hypothesis more tenable but it does not prove it.

Yes, it is giving a some kind of an understanding that yes education is related, but we cannot prove it. What about the effect of the other possible causal factors such as income because it is possible that a person when he is educated, his ability to earn more also increases, so that is

why it is not education but rather a higher income that has been resulting in the higher purchase of the fashion clothes. So it could also be possible that a person with low education can also be earning high, so because earning not necessarily depends on the education.

So that is why we see we cannot claim that education has a direct impact on the purchase. Fashion clothing can be expensive, so people with higher incomes may be more able to afford them. It is possible that considering a third variable now if you take a third variable will crystallize and association that was originally obscured or irrelevant. The time and order of the occurrence of variables provides additional insights into causality. So in such a condition, maybe we need to take a third variable which can make our statement more effective or our experiment more fruitful.

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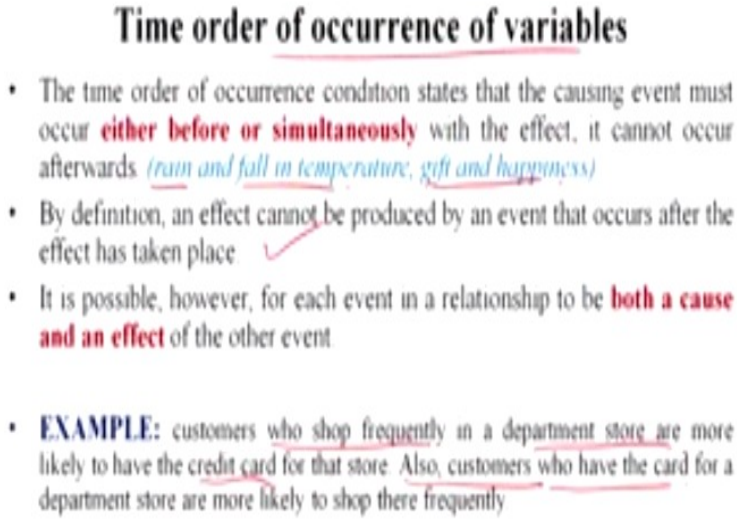

Similarly time order of the occurrence, so we say during causality the order of occurrence of the variables also plays an important part. Now let us see this. The time order of occurrence condition states that the causing event must occur either before or simultaneously, not after with the effect. It cannot occur afterwards. Rain and fall in temperature, so when there is a rain right, there is automatically a fall in temperature. It is not that the rain completes and then only the fall in temperature starts, it is as soon as the rain happens, the fall in temperature starts beginning.

So it is either before because of the cold wind that blows, so the temperature goes down, or because of the rain the temperature goes down. So it is either before or simultaneously. Gift and happiness, so as soon as you give a gift and the happiness . So these two effects you can

see, they happen before or the happen simultaneously. By definition, an effect cannot be produced by an event that occurs after the effect has taken place because then if it happens after, then you cannot say it has happened because of this particular cause.

It is possible, however, for each event in a relationship to be both a cause and effect of the other event. So let us see this example. Customers who shop very frequently in a department store are more likely to have a credit card. So if you are a regular visitor of a particular mall, for example let us say Wal-Mart or Big Bazaar, then you might be having a credit card for that store. On the other way if you see it, also customers who have a credit card for other particular store will also be having a tendency to buy more frequently.

So this is how they are connected, so the both cause and effect are affecting each other, the event of purchasing.

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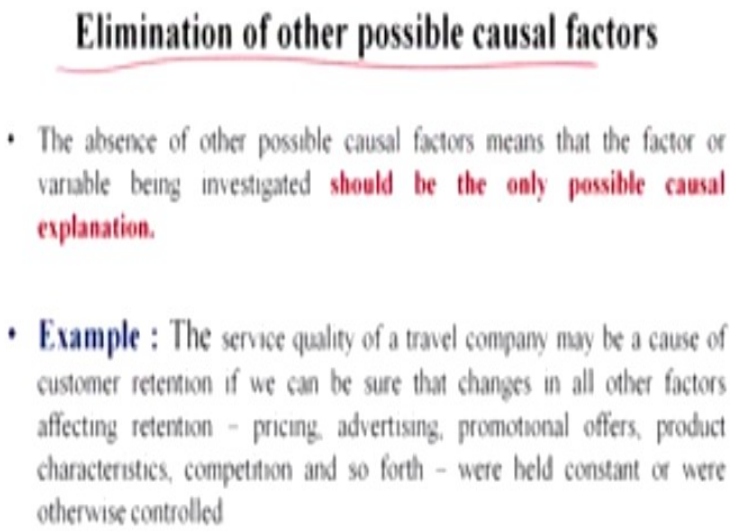

Elimination of other possible causes. So when you are studying a causality, there you have to eliminate the other possible factors, otherwise if you do not eliminate them, then you cannot say that A is the cause for B, that means A causes B you cannot claim it. So to do that in order to know sometimes what is the basic reason why something suppose that the score of a student is increasing or what effects the score of a student, now we will say the amount of hard work.

To say that amount of hard work, we have to control other variables, may be his regularity in the class, his behavior in the class and other things. So if you cannot control other factors,

then we cannot claim it is only hard work that is giving rise to better performance or lower performance, obviously better performance. So the absence of other possible causal factors means that the factor or variable being investigated should be the only possible causal explanation.

Example the service quality of a travel company, the service quality may be a cause of customer retention if we can be sure that changes in all other factors effecting retention like what price, advertising, promotional offers, product characteristics, competition etc were held constant. If you can hold a constant and then see whether there is any change in the retention or not, then only you can claim that service quality was responsible for retention or not possible for retention.

If you cannot control these other variables, then you cannot claim it. Then that leads to a fall in the internal validity, which I will explain later.

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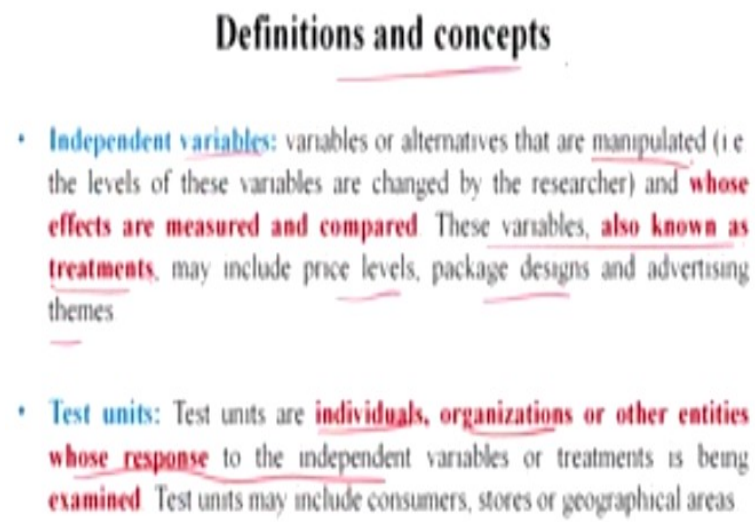

Some of the definition and concepts which you need to understand in a causal experiment, a causal study. Independent variables. So what are the independent variables? These are the variables that are manipulated, so we try to change the level of these variables and see the change in the effect of the outcome or the dependent variable. So these variables are also known as treatments. So we have different levels of treatment and when we change the level of treatment, we try to see the effect on the dependent variable. So may include price levels, package designs, advertising themes, method of teaching, and the outcome could be the final score of the student similarly

Test units what are these? Individuals, organizations, or other entities whose response to the independent variables or treatment is being examined. So these are the individuals from whom we are collecting the data for example. So they may include the consumers, stores, or geographical areas.

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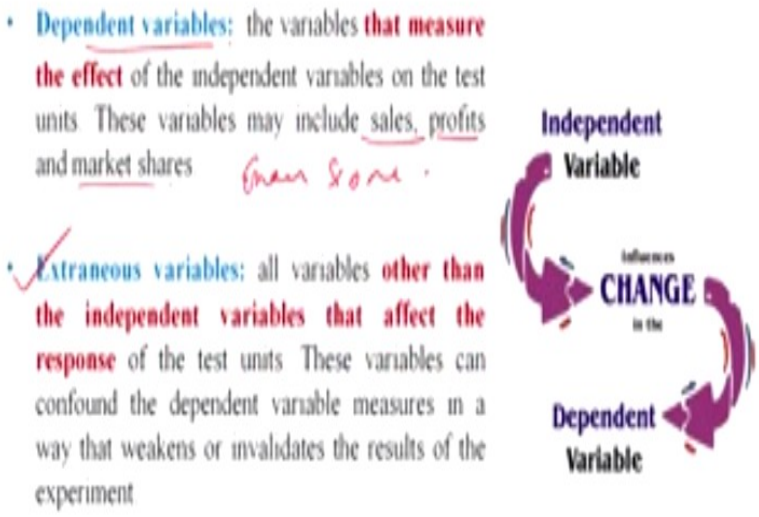

Dependent variables, what is it, the effect. So we are saying the effect. Finally what effect we are finding out is called the dependent variable and they dependent on what, the cause which is the independent variable. So this may be like sales, profits, market share, exam score, etc. Now what is this extraneous variables. Extraneous variables, all the variables other than the independent variables that affects the response of the test units are called extraneous variables.

These variables can confound the dependent variable measures in a way that weakens or invalidates the results of the experiment, that means what? When we talked about this particular case where the service quality we were saying effects the retention, but if we do not understand whether the price has been constant or it has changed because if the price also changes, then we cannot claim that it is only it is the service quality that is responsible but may be the price also has an effect on the retention.

So there the price is the extraneous variable which might be having an impact on the dependent variable which is the retention of the customer. So what is it saying, independent variable influences change in the dependent variable.

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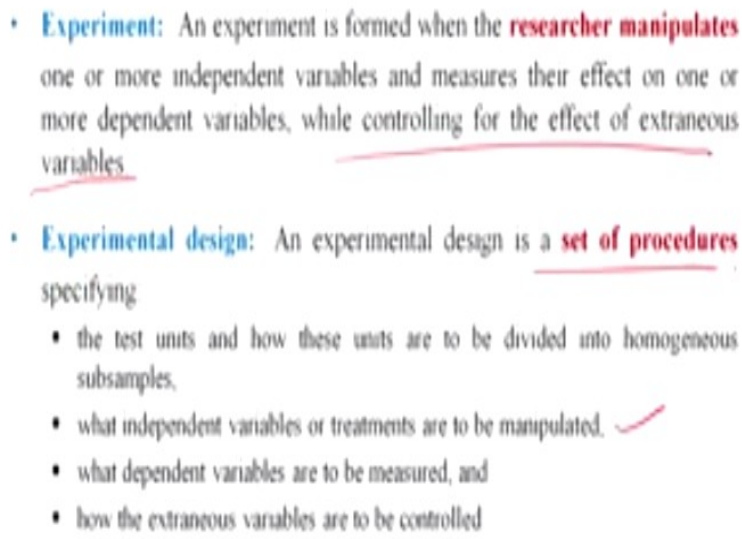

Experiment, an experiment is formed when the researcher manipulates one or more independent variables and measures their effect on one or more dependent variable while controlling the effect of extraneous variables. So when you control for the extraneous variables and you check the effect of the independent variable on the dependent variable, that is when you say this experiment has been successfully covered.

So what is the design, experimental design? It is a set of procedures specifying the test units and how these units are to be divided into homogenous subsamples. How do you want to divide the test units so that you can make your experiment in an effective manner. What independent variables are to be manipulated or treatments are to be manipulated. Which are the independent variables and how do you want to manipulate that also we have to take care while making your experimental design.

What are the dependent variables that need to be measured, finally how do you control the extraneous variables. These four things are very important. First how do you divide your sample or test units into homogenous subsamples, second which are the independent variables you need to control or you need to manipulate, third what is the dependent variable you want to measure, fourth what are the variables that you want to control so that the effect of the independent variable is more clear.

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Definition of symbols

To facilitate discussion of extraneous variables and specific experimental designs, we define a set of symbols now commonly used in marketing research:

- X = the exposure of a group to an independent variable, treatment or event, the effects of which are to be determined
- O = the process of observation or measurement of the dependent variable on the test units or group of units
- R = the random assignment of test units or groups to separate treatments

Just some of the symbols that we will use. What is X, X is the exposure of a group to an independent variable, treatment or event. The exposure of a group, group means a group of respondents, to an independent variable so that we will see the effect on the dependent variable of which the effects are to be determined, that is what I am saying. What is O, the process of observation or measurement of the dependent variable on the test units. So whatever the dependent variable the scores are that is what you are talking about in the observation.

What is R, the random assignment, you want to randomly assign. If there is no random assignment, there is chance of biasness. If there is chance of a biasness, then the validity of the study gets weakened so that is why we will encourage random assignment that means you can randomly choose the sample or randomly put in the use the variables in the study.

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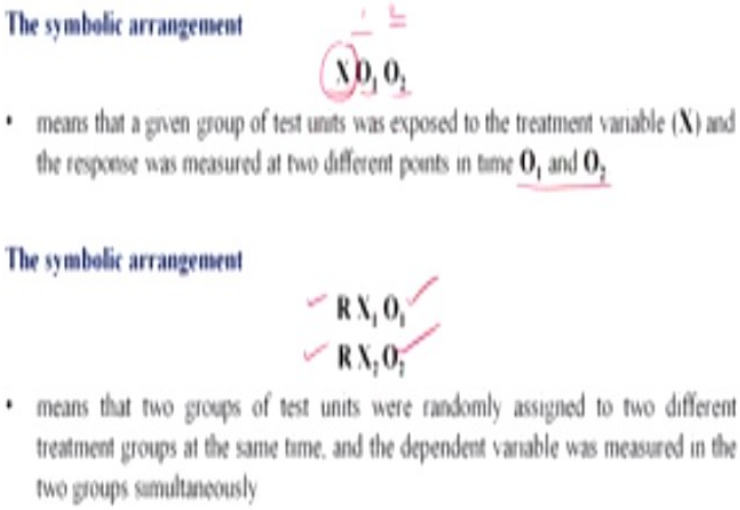

What is the symbolic arrangement you see. Now this is exposure, this is O_1 and O_2. It means that given group of test units was exposed to the treatment variable X, treatment variable is X and the response was measured at two different points in time. Let say year 1 year 2. After giving a treatment to a group of respondents, let us say a group of students. So you check the score in the first term and then the second term. Similarly what does this mean, it means that two group of test units 1 and 2 were randomly assigned to two different treatment groups.

So treatment groups are 1 and 2. So what are the treatment groups, the subsamples that you have divided randomly and the dependent variable was measured in the 2 groups. So you have measured, this is O_1 and O_2, 2 groups simultaneously. So you have put in 2 you have divided into 2 groups right X_1 and X_2 and randomly you have put in the treatments and then measured the final result.

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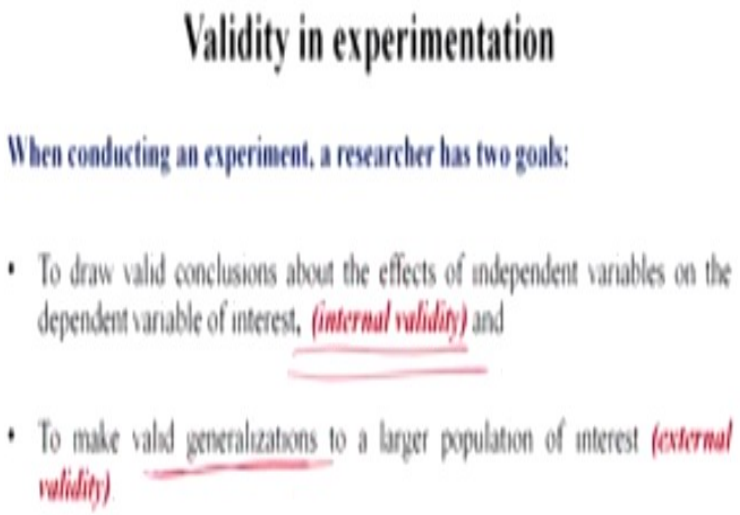

What is this validity and why is it important. The word validity means that it is valid as good as that, that means what when conducting an experiment, researcher has two goals, one to draw a valid conclusions about the effects of the independent variable that means I am saying that whatever outcome has happened, it is because of the independent variables that I have chosen or I have used for manipulation or the treatments that I have chosen.

So to draw valid conclusion about the effects of the independent variables on the dependent variable of interest, we call it as internal validity. So that means in simple terms, I will say that these are the independent variables and which have an effect on the dependent variable of our study. So if yes, this is true, that yes these are the only independent variables which are effecting our depending variables then we will say we are doing good and we have strong internal validity.

Second is can the study that we have made can be generalized to a larger population that what he is saying. To make valid generalization to a larger population of interest is called external validity, that means what two things, one internal and the other is external. Internal that means the right independent variables you have chosen which effect the dependent variable and external validity happens when the study that you have done can be experimented or taken further can be to a larger population and then we can say well it is applicable everywhere, then it is true there is an external validity.

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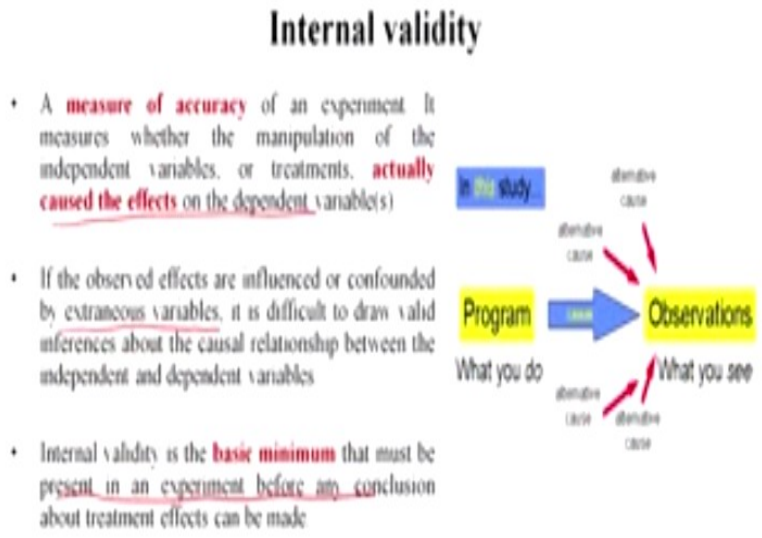

A measure of accuracy, internal validity, it measures whether the manipulation of the independent variables actually cause the effects on the dependent variable. Is the change in the dependent variable happens due to this independent variables or not? The accuracy level will determine the internal validity. If the observed effects are influenced or confounded by other variables which are called extraneous variables.

It is very difficult to draw a valid inference about the causal relationship and then you cannot claim that yes this treatments have resulted into the outcome. Internal validity the basic minimum that must be present in an experiment before any conclusion about the treatment effects can be made. So if there is no internal validity, then you cannot claim that the treatments have been responsible for the effect.

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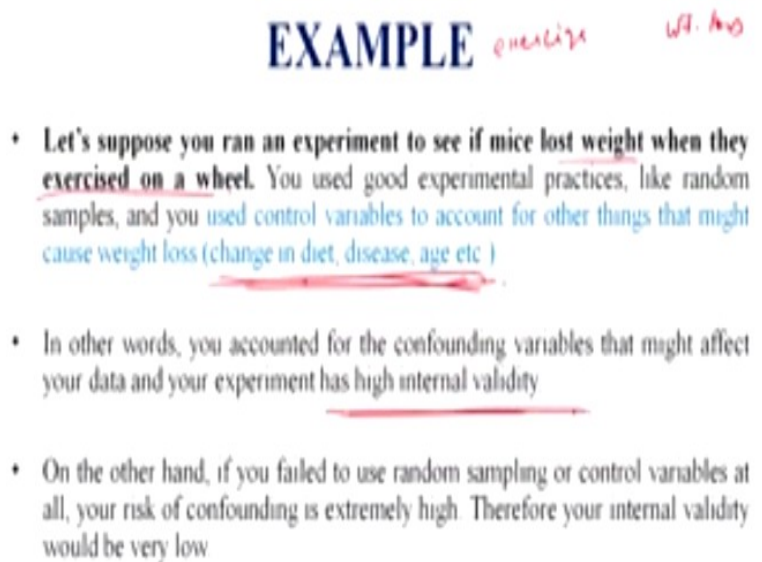

Let us suppose you ran an experiment to see if mice lost weight when they exercised on a wheel. So you put in some mice and you made to run them. You used good experimental practices like random samples you chose a random sample of mice right and you use control variables to account for other things that might cause weight loss. So change in diet, disease, age, etc. So you ensured that the diet given is more or less the same, the mice are all of the similar health condition, and the age is also similar to each other.

So that means what, these things are kept constant. So we cannot say that may be due to change in diet or disease or age that has been responsible for the weight loss. So taking control in these 3,we are saying whether exercising on the wheel will it reduce the loss in weight, so the only independent variable is exercise and the dependable variable effect is the weight loss, other things we have kept constant. So what it says is in other words you accounted for the confounding variables that might affect your data and your experiment has high internal validity.

If you have control this experimental variables, the confounding variables or the extraneous variables, then you can say then there is a high internal validity. Other hand if you fail to use random sampling that means you randomly choose the mice group or the control variables at all, your risk of confounding is very very high, that means therefore your internal validity would be very low, you cannot claim. If you have not selected the samples randomly or you have not been able to control the extraneous variables clearly, then you cannot claim there is internal validity which is a basic requirement of any experiment.

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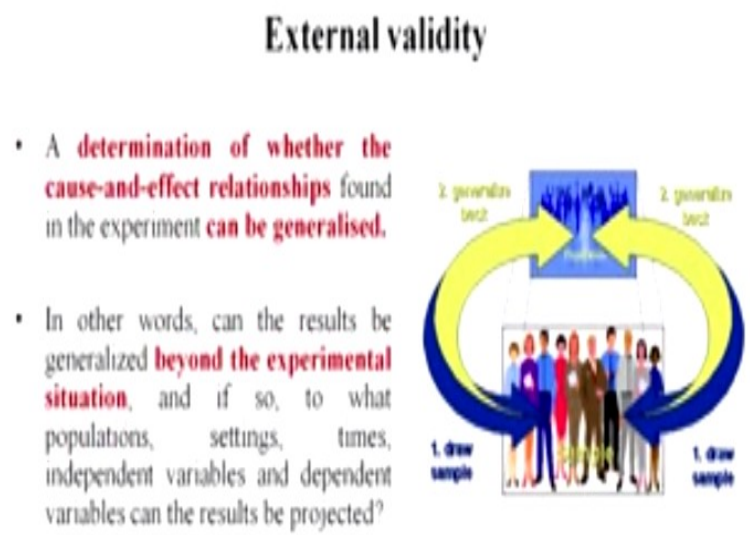

So we said it should be applicable to everywhere. A determination of whether the cause and effect relationship can be generalized. In other words, the results be generalized beyond the experimental situation. So that means what we are saying. Can we use this study what we have made can it be of extrapolated to the entire population. If it is yes, then we have a high external validity. If no, then poor external validity or no external validity.

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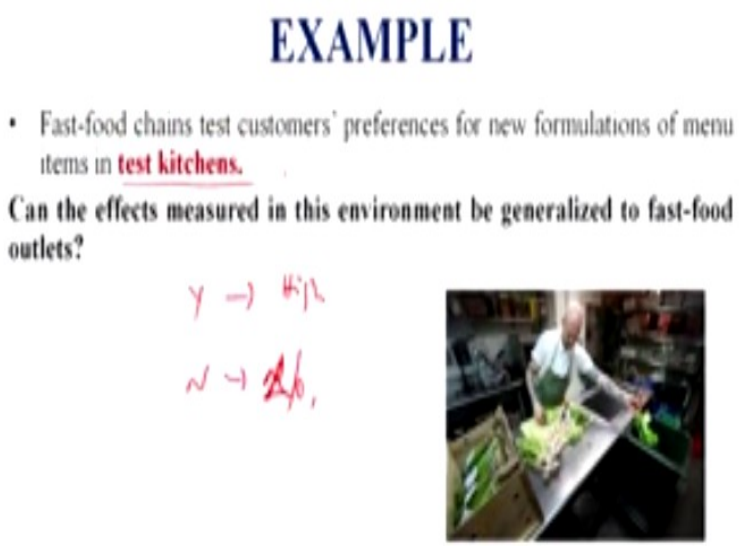

Example fast food chains test customer preferences for new formulations of menu items in test kitchen. Can the effects measured in this environment be generalized to fast food outlets, yes no. If is yes or no. If it is yes, then high external validity. If it is no, then low or no external validity okay correct.

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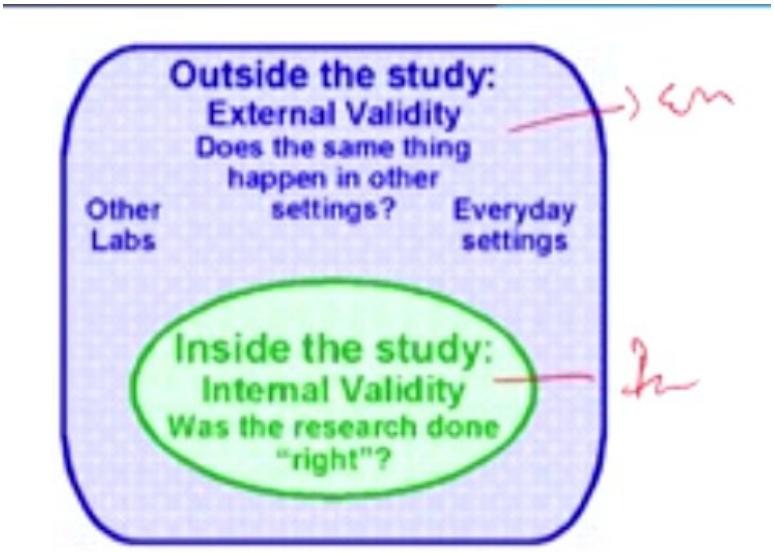

So this is what it looks like, inside the study internal validity was the research done it, and outside the study external validity. Does the same thing happen in other settings, in a lab setting or everyday normal setting. Then this is for the external validity, this is for the internal validity.

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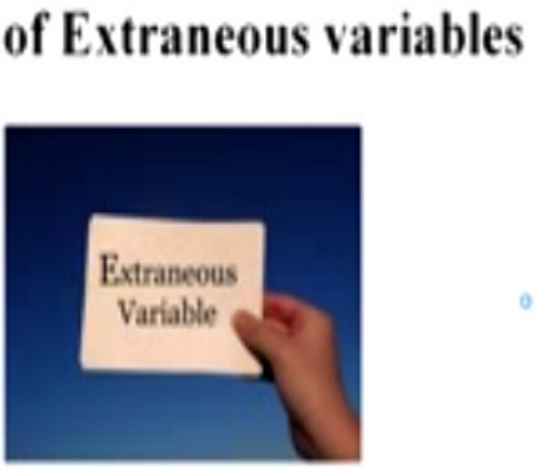

Now what are the types of extraneous variables, let us see.

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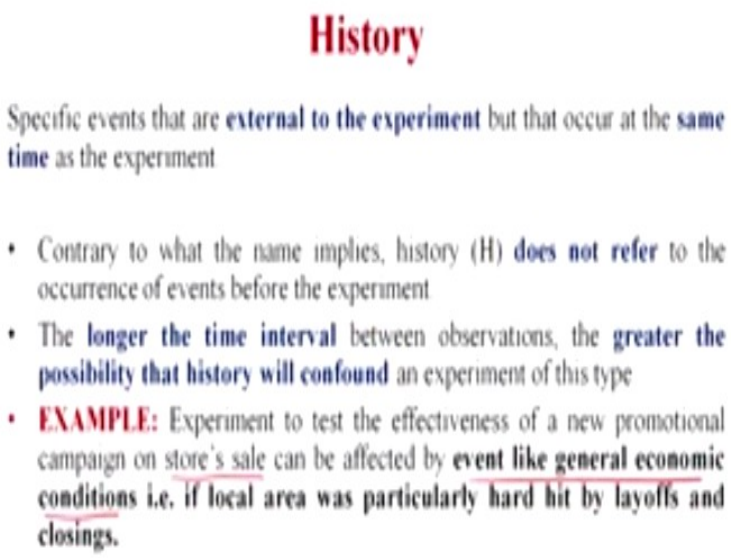

The first is history. What is history means, specific events that are external to the experiment but that occur at the same time. Now that is very interesting, now what does it mean and how it effects let us see. It does not mean the past, history means does not mean the occurrence of events before the experiment, it does not mean it this way here. Let us take this case. The

longer the time interval between observations, the greater the possibility that history will confound an experiment of this type.

Let us see this example experiment to test the effectiveness of a new promotional campaign on the stores sale can be effected by event like general economic conditions. So let say you want to check the effect of the new promotional campaign on the sale of a store. Now if you are doing it, then so whatever results come that result could be effected may be by the economic conditions of the country or the global economic conditions.

So if the economy is hit hard by layoffs and closings, then the results whatever you will get might not be exactly the true nature of the effect of the sales promotion on the store sales. So this is called history. So any variable happening at the same time and how it effects the final study.

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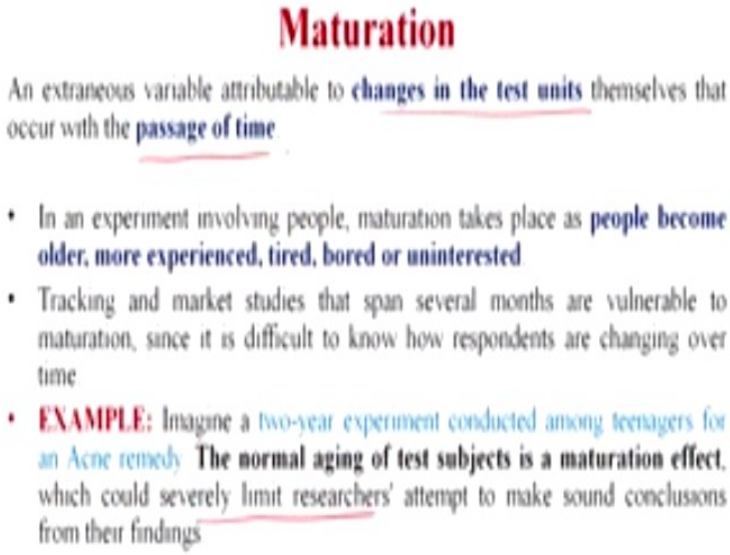

Maturation, what is maturation, so another extraneous variable or an extraneous variable attributable to changes in the test units that occur with the passage of time. Now what is it mean matured, you become matured with time. So sometimes you become matured your ages increases, your knowledge increases, so with the increase in knowledge, with your decrease in physical strength, your way you approach a problem also changes. So let us see this. In an experiment involving people, maturation takes place as people become older, more experienced, tired, bored or uninterested.

Examine a 2-year experiment conducted among teenagers for an acne remedy, the normal aging of test subjects is a maturation effect. So it is a normal aging process which is a maturing effect which could severely limit the researchers attempt to make sound conclusion from their findings. So suppose you are using some kind of treatment then you cannot claim that the same treatment effect holds true because with time there is a change in the maturation of the subject.

So either his age is improving, so he has learnt better way to handle his acne or he has learned how to effectively utilize the medicine in a better way, so these things can also effect the final outcome of the study, that is why this is also an extraneous variable.

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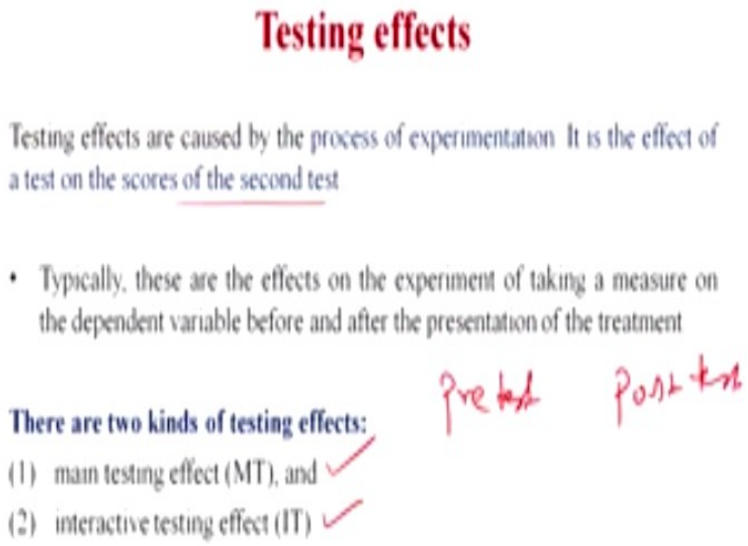

Testing effects. So testing effect means the test effects are caused by the process of experimentation. It is the effect of a test on the scores of the second test, that means what. If I do a test now and then I do the test again, my first test, the experience will lead to an effect in the second test. So typically these are the effects on the experiment of taking a measure on the dependent variable before and after, so before is pre and after is post, pretest and posttest are the treatment.

So there are two kinds of testing effects, one main testing effect, second interactive testing effect. Now what does this testing effect mean, let us understand

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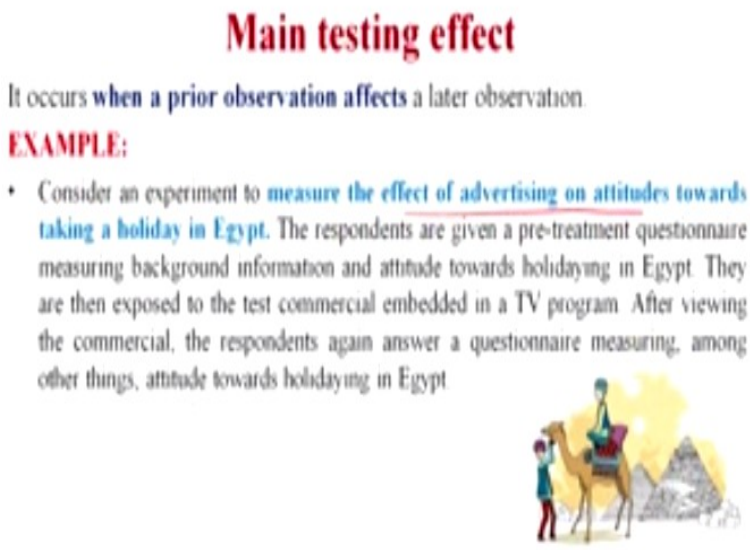

So main testing effect means let us say it occurs when a prior observation affects a later observation. Let us take this example. Consider an experiment to measure the effect of advertising on attitude towards taking a holiday in Egypt okay. So what is the effect of advertising to take a holiday in Egypt. Respondents are given pretreatment questionnaire measuring background information and attitude towards holidaying in Egypt.

They are then exposed to the test commercial, they had made an advertisement also test commercial, and they are exposed to the test commercial. After viewing the commercial, the respondents are again asked the same question what is their opinion about visiting Egypt. So the attitude might have changed, may be earlier it was bad, now it has become better or earlier it was very good, it has now become bad whatever. So the difference between the pre and post treatment attitude is called the main effect.

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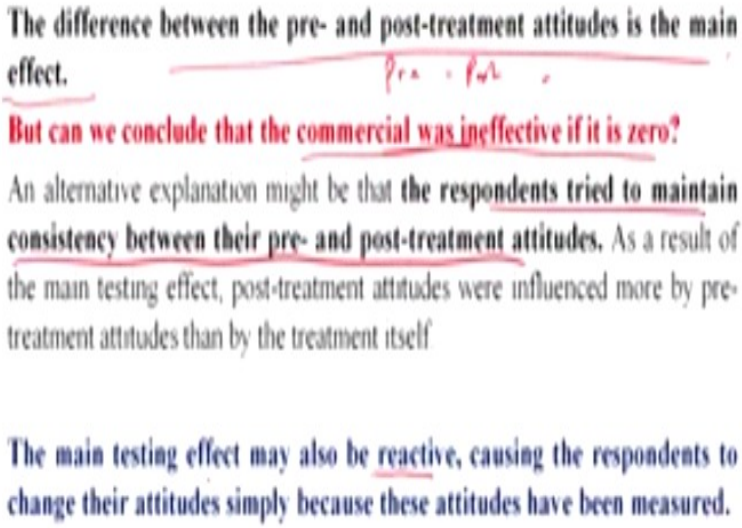

So main effects are called direct effects basically, so there is no interaction or intervention of anything else, but can we conclude that the commercial was ineffective if the let us say pre and post difference is zero, Can you claim that the commercial was ineffective? Not necessarily, why? May be the respondents tried to maintain a consistency between the pre and post treatment attitudes, so you cannot claim that the commercial was ineffective, but the main testing effect may also be reactive causing the respondents to change their attitudes simply because these attitudes have been measured.

They sometimes, the subjects of treatment, they become very sensitive and they feel take it in a positive or negative manner and accordingly the final results will change because the sensitivity will have an effect on the final outcome or the effect of the study. So these are to be very careful. So the testing effects have to be very carefully tested and checked while doing an experiment. Now next thing is interaction effect.

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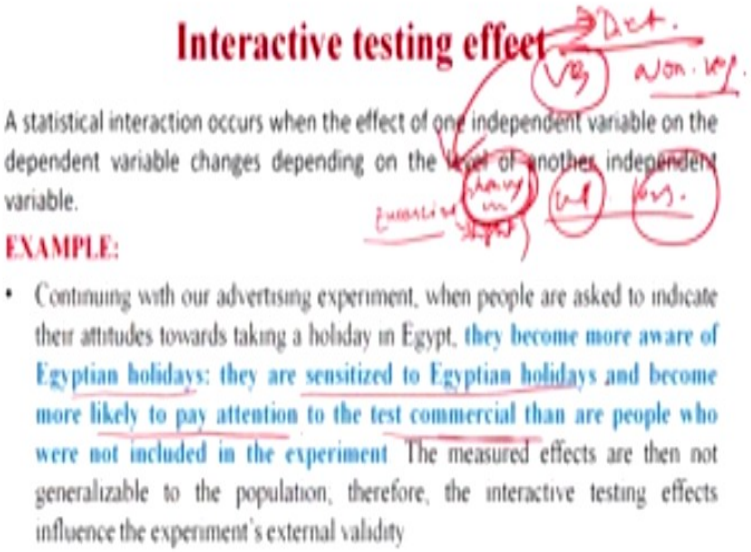

Interactive testing effect

A statistical interaction occurs when the effect of one independent variable on the dependent variable changes depending on the level of another independent variable.

EXAMPLE:

- Continuing with our advertising experiment, when people are asked to indicate their attitudes towards taking a holiday in Egypt, they become more aware of Egyptian holidays: they are sensitized to Egyptian holidays and become more likely to pay attention to the test commercial than are people who were not included in the experiment. The measured effects are then not generalizable to the population, therefore, the interactive testing effects influence the experiment's external validity

What is this interactive or interaction effect? It says a statistical interaction occurs when the effort of one independent variable on the dependent variable changes depending on the level of the other independent variable. So what it says, the effect of one independent variable on the dependent variable changes depending on the level of another independent variable. Now let us continue with the same example. When people were asked to indicate their attitude towards taking a holiday in Egypt, they became more aware of the Egyptian holidays.

So now there were two groups let us say, so one group now you can understand, let this group only has become more sensitive they have learned more about Egyptian holidays, they are aware of it. So next time when you ask them, so they are sensitized and become more likely to pay attention. Next time when you ask them, they start paying attention and show eagerness towards the subject and because of this, the test commercial that they showing, they show more interest and they watch it more keenly, so now the effects will be different.

Take for an example, you have taken another example I am giving you so to measure the interactive effect. For example let us say you want to see the effect of, I am giving this very different example, let us say effect of exercise on weight loss. So there are two ways we are doing exercise one is heavy exercise and light exercise. So we can have a study where only the independent variable exercise is having two levels has an effect on weight loss.

Now this is a study which tells about the main effects, but suppose I introduce another variable into the study which is let us say the diet, now vegetarian and non-vegetarian. So when I am introducing, so now this person who is a heavy exerciser and who has a vegetation

taking vegetarian food and a heavy exerciser who is consuming a non-vegetarian food, for both of them the weight loss would be different. So this change in weight loss has now happened because of the presence of the other independent variable that is diet.

So that is what it says in an interaction effect during the main effect, we did not check into any other effects besides the treatment effect that is the independent variable effect, but here since there is one more independent variable and the level of this independent variable now is influencing the final result that is the weight loss, so then we are saying it is not any more a direct effect or it is not a main effect but it is an interaction effect which is happening due to the interaction between exercise and diet.

So when exercise and diet are interacting or interacting with each other, a new kind of a result is emerging, so this effect is called an interaction effect. So whenever you are doing a study any researcher is doing a study, he needs to check very clearly the main effect versus the interaction effects, sometimes the main effects might be very strong but sometimes the main effects could be very weak whereas the interaction effect would be very very strong because, let say the only exercise on weight loss might be very very insignificant or insignificant effect.

Only effect of diet on weight loss could be also insignificant, but if a person takes both diet and exercise together, the effect could be extremely significant and this is want we say as an interaction effect. So sometimes, interaction effects can be more stronger than the main effect. Well this is what we are going to do for today. In the next continuing lecture, we will continue with some of the more extraneous variable effects and we will go for that. Thank you so much.