Module 02 Lesson 04
VoiceThread: Basic Experimental Design
Transcript

Now that you have a better understanding on how the scientific method works, let's take a look at the difference between good and bad experiments.

[Visual: text that states "Experiment 1" is displayed. The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals fast food for a period of 4 weeks. The final area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals."]

If we return to our fast food experiment 1, we concluded that fast food consumption led to weight gain because all 20 individuals gained weight over the 30 day period.

While this seems like a valid conclusion, what if I asked you, "How certain you could be that these same 20 individuals would not have gained weight over the same 4 week period if they had been fed on just a regular diet?"

I am guessing that you cannot be sure and thus even from this simple question, it should be apparent that experiment 1 does indeed suffer from certain limitations.

It is therefore important to have well planned and well designed experiments if there is to be any reliability in the data generated.

As such, well-designed experiments usually overcome the limitations that we have in experiment 1 by including both experimental and control group individuals.

Experimental (treatment) group is basically just a group of subjects who are exposed to a particular treatment. In our example, it was those individuals that were given fast food as apposed to a regular diet. So in effect, our experiment 1 only included a treatment group.

The control group on the other hand is a separate group of subjects who are treated the same as the experimental group, except that they are not exposed to the treatment. So in our example, they would be individuals that were given a salad or regular diet and not fed fast food.

So all a good experiment is really trying to do is to minimize any differences between the control group and the experimental group, other than the treatment itself.

Based on these simple principles of experimental design, perhaps a better more refined experiment may look something like this:

[Visual: text that states "Experiment 2" is displayed. There are two blocks. The first block has the text "Treatment group." The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals fast food for a period of 4 weeks. The final area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals."

The second block has the text "Control group."] The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals regular diet for a period of 4 weeks. The final area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals."

There is also text that states "Individuals represent a random sample of males and females between 20-40 years of age.]

It should be easy for you to see that this new experiment 2 is in fact a far better design than the original experiment 1 merely because it includes a control group.

If we look at the results obtained from experiment 2:

[Visual: text that states "Experiment 2" is displayed. There are two blocks. The first block has the text "Treatment group." The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals fast food for a period of 4 weeks. The next area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals." The final area in the graphic displays an arrow pointing to the right with the text "17 of the 20 individuals gained weight over the 4 week period."

The second block has the text "Control group."] The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals regular diet for a period of 4 weeks. The next area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals."] The final area in the graphic displays an arrow pointing to the right with the text "5 of the 20 individuals gained weight over the 4 week period."

There is also text that states "Individuals represent a random sample of males and females between 20-40 years of age.]

While the conclusion from experiment 2 may seem the same as experiment 1, in that it appears that fast food does lead to weight gain, experiment 2 has controlled for other factors by using a control group, and as such you can have much greater confidence in experiment 2's outcome.

So returning to your hypotheses once again, you would reject your Null hypothesis and accept the Alternative hypothesis.

Hopefully this whole process of hypothesis testing is starting to make more sense. But what if the results from experiment 2 actually looked like this:

[Visual: text that states "Experiment 2 - what if?" is displayed. There are two blocks. The first block has the text "Treatment group." The first area in the graphic to the left side states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals fast food for a period of 4 weeks. The next area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals." The final area in the graphic displays an arrow pointing to the right with the text "17 of the 20 individuals gained weight over the 4 week period."

The second block has the text "Control group."] The first area in the graphic to the left side *states "Start (day 0). Weigh 20 individuals. There is an image of a person on a scale. The center of the graphic displays an arrow pointing to the right with the text "Feed the 20 individuals regular diet for a period of 4 weeks. The next area in the graphic to the right side states "Finish (day 30). Weigh 20 individuals."] The final area in the graphic displays an arrow pointing to the right with the text "15 of the 20 individuals gained weight over the 4 week period."*

There is also text that states "Individuals represent a random sample of males and females between 20-40 years of age.]

In this case your conclusion may be entirely different and you may not be able to conclude that the results are convincing enough to say that fast food is in fact causing weight gain.

As such in this case you would accept your Null hypothesis that states that fast food consumption has no effect on weight gain.

Now think back to experiment 1 where there was only a treatment group that showed that all 20 individuals gained weight from eating fast food for a four-week period. How valid do you think experiment 1's conclusion would be in light of these new results?

Hopefully this question will help to reinforce the importance of using adequate controls in good experimental design. And also the use of the converse example here also highlights the importance to realize that if the experimental results are not what you were expecting, it does not mean that you made a mistake or that your answer is wrong. Remember there are no right and wrong answers in science, rather the data that is generated is used to test your hypothesis.

So in conclusion, it is important to realize that science is a fluid process that involves a lot of trial and error over time, so if your conclusions do not support your hypothesis, then you can revise your hypothesis, and start the experimental process over again.