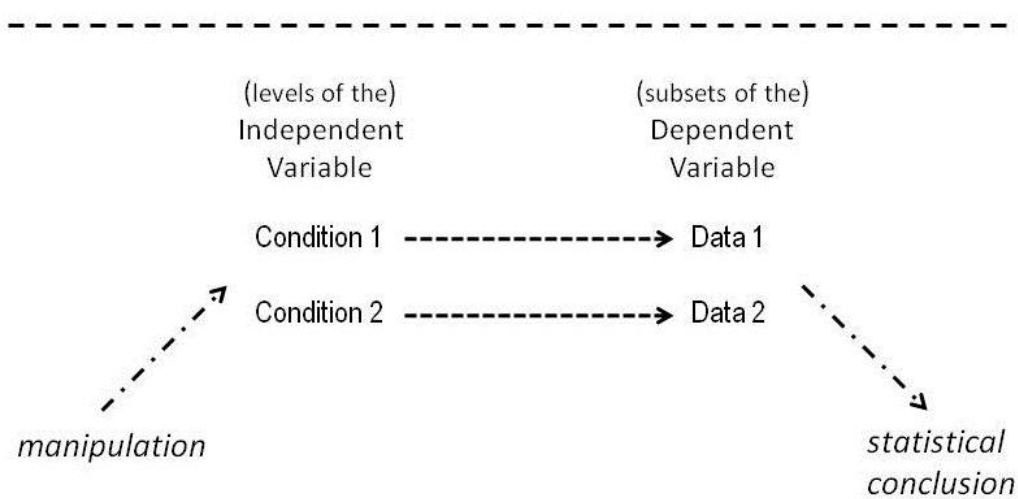
Pre-lecture Notes II.1 – Introduction to Experiments

In general, an experiment is when you manipulate one thing (e.g., how bright the room is) and look for a difference in another thing (e.g., mean number correct on a memory test).

The thing that you are manipulating, assuming that you have complete control over it, is referred to as the ***independent variable***. (The name comes from the fact that you have complete control over it, so it is *independent* of everything else.) Because, in most cases, you can't include every possible version or level of the independent variable (since that would force you to run a ridiculously huge experiment), you usually end up choosing a relative small number of versions or levels (e.g., only two: very bright room vs. almost dark room); these are the ***levels of the independent variable***. Each level of the independent variable corresponds to a ***condition*** of the experiment.

The thing that you are measuring in your experiment is referred to as the ***dependent variable***. (This name comes from the fact that you are conducting the experiment in order to see if this thing *depends* on the independent variable.) In order to do this you must, of course, keep the data from each condition separate. In other words, you keep track of subsets of the data, with each subset corresponding to one level of the independent variable.

Here is a picture that summarizes the core components of an experiment:



Before anything else, note the dashed line across the top of the figure. This indicates that everything in this picture is "below the line" – i.e., this picture only includes observable things. In other words, none of this has anything to do theoretical constructs and so, for now, you can forget about construct validity.

Next, note the distinction between the *manipulation* and the (levels of the) independent variable. The manipulation is what you did to create the conditions; the levels of the independent variable are the specific conditions that were created by the manipulation. For example, in our example experiment concerning room brightness and memory performance, the manipulation might be something like turning a dial up and down to raise and lower the voltage to the lighting system, while the levels of the independent variable might be something like 1500 lumens [which is bright lighting] vs. 150 lumens [which is rather dim lighting].

The reason for making this distinction between what you did to create the conditions (i.e., the manipulation) and the conditions that were created by the manipulation (i.e., the levels of the independent variable) relates to the first of the two kinds of validity that will be covered in this part of the course:

Internal Validity – *the extent to which a significant IV-DV relationship is causal and not spurious*

(where ***IV*** is independent variable and ***DV*** is dependent variable)

To begin to see what this definition of internal validity really means, start with the assumption that we have conducted the lighting/memory experiment and found that people remember more items on average when the room is brightly lit than when it is almost dark. From this, you might be tempted to conclude that brighter lighting *causes* better recall. In other words, you might be tempted to conclude that there is a causal relationship between the IV in the experiment (lighting condition) and the DV in the experiment (mean number of items remembered). And, all else being equal, that's a very reasonable conclusion to make.

But what if I now told you that, when we turned the dial up and down (i.e., when we did the manipulation), we not only changed the brightness of the room, but we also added or subtracted a buzzing noise. For example, when we turned the dial down to reduce the voltage to the lighting system, we not only made the room less bright, but also caused the lighting system to start buzzing. (FYI: most fluorescent lighting systems actually do this.) Conversely, when we turned the dial up to increase the voltage, we not only made the room brighter, but we also eliminated the buzzing noise. In other words, the two conditions of the experiment were different in more than one way: yes, the "very bright room" condition was brighter than the "almost dark room" condition, but the "very bright room" condition was also quieter than the "almost dark room" condition. This brings us to a second definition:

Confound (*noun*) – *an extraneous variable that changes in parallel with an IV*

(where "extraneous variable" is any aspect of the experiment that is not of current interest)

In the example above, the confound is the buzzing noise. It's a confound because it is changing in parallel with the IV (room brightness), but is not of current interest.

Now we are getting close to the meaning of internal validity. The trick, in this case – now that you know that buzzing noise was confounded with brightness – is to ask yourself whether it is still reasonable to conclude that brighter lighting *causes* better recall. I hope that you'll agree that our original conclusion is no longer on very solid ground. It's just as likely (if not more so!) that buzzing noises cause lower recall as it is that bright lights cause higher recall. This lack of confidence in the "realness" of the targeted IV-DV relationship is what we mean when we say that an experiment has a low level of internal validity. Conversely, if there are absolutely no confounds – which means that the one and only difference between the conditions is that which defines the levels of the IV – then you would have a very high level of internal validity and, therefore, you would have very high confidence that any significant effect of the IV on the DV is really due to a causal relationship between the two.

In a nutshell, one very important measure of the quality of an experiment concerns the extent to which everything other than the independent variable was held constant (equal) across the conditions. This concept is more than half of the second part of the course.