**Independent and Dependent Variables**

In order for a study to be run properly, there has to be at least one independent and dependent variable. Independent Variables are also called manipulated variables and factors. Independent variables are variables that are manipulated or changed within an experiment. Doing so allows you to observe if the changes that are being made with the independent variable(s) causes a change in other variables. These other variables are called dependent variables.

Dependent variables are variables that are *dependent* on the independent variable(s). These are variables that are the presumed effect. It is what is being measured in an experiment. For a successful study, dependent variables should be measured precisely. For instance, in Figure 1, investigators are interested in discovering the position of participants in relation to the number of successful shots made. Here, the manipulated variable is the change in positions (standing up, kneeling, and propped up) located on the x-axis and the variable being measured or the dependent variable is the number of successful shots being made, which is located on the y-axis.

![Figure 1: Graph showing independent and dependent variables](image)

**Main Effect**

The main effect is the effect that the independent variable(s) will have on the dependent variable(s) while ignoring the effects of all other independent variables. In other words, it is the unique effect of an independent variable on an outcome variable. Generally, there is one main effect for every independent variable in a study. With a study with only 2 independent variables, you will have 2 main effects. For a 4-way interaction you will have 4 main effects, 6 2-way interactions, 4 3-way
interactions, and 1 4-way interaction. Below is an example of a 4-way interaction using a,b,c, and d as independent variables.

4-way interactions: a, b, c, d

main effects (4): a, b, c, d
2-way interactions (6): a*b, a*c, a*d, b*c, b*d, c*d
3-way interactions (4): a*b*c, a*b*d, b*c*d, a*c*d
4-way interaction (1): a*b*c*d

Control and Random Variables

Control variables (or constant variables) are any and every variable that is to be kept constant in the scenarios of your experiment. These variables are kept constant to observe the effects of the independent variables on the dependent variable efficiently. For example, if you are studying font color pertaining to reading comprehension. The independent variable that is manipulated is the font color. The dependent variable is the measure of reading comprehension. The control variables are the size of the font, font family, screen brightness, etc.

Random variables are uncontrollable circumstances that arise in studies. For example, to study if the position or stance or individuals control performance on Guitar Hero, the independent variables could be sitting and standing. Notice that there could be other modifications among these variables (standing could include leaning on wall, standing straight, etc.). The dependent variable would be the performance measured by the score made by the users on a particular song. The control variable would be the particular song that is used. The random variables would include the experience of guitar hero of participants or noises within the environment such as footsteps in the hallway outside of the research study room. The more control you have, the more you increase the external validity of your study.

Validity

Validity is the extent to which a test measures what it claims to measure. Since we are unable to test the whole population, it is important for your findings to represent the wider population in real-world situations. There are two types of validity: external and internal validity. External validity is the extent to which results of a study can be generalized to the world at large. For instance, a system that is to be used outdoors but is being tested indoors only is a possible threat to external validity. Internal validity is the confidence we can place in the cause and effect relationship in an experiment. Controlling as many extraneous variables as possible that would influence the results of the study increases the internal validity of a study.
Resources


http://wbtforme.blogspot.com/2013/04/5-step-lesson-plan-independent-variable.html

http://psychology.about.com/od/researchmethods/f/validity.htm