Research Variables

The research variables, of any scientific experiment or research process, are factors that can be manipulated and measured.

Any factor that can take on different values is a scientific variable and influences the outcome of experimental research.
Gender, color and country are all perfectly acceptable variables, because they are inherently changeable.

Most scientific experiments measure quantifiable factors, such as time or weight, but this is not essential for a component to be classed as a variable.

As an example, most of us have filled in surveys where a researcher asks questions and asks you to rate answers. These responses generally have a numerical range, from '1 - Strongly Agree' through to '5 - Strongly Disagree'. This type of measurement allows opinions to be statistically analyzed and evaluated.
Dependent and Independent Variables

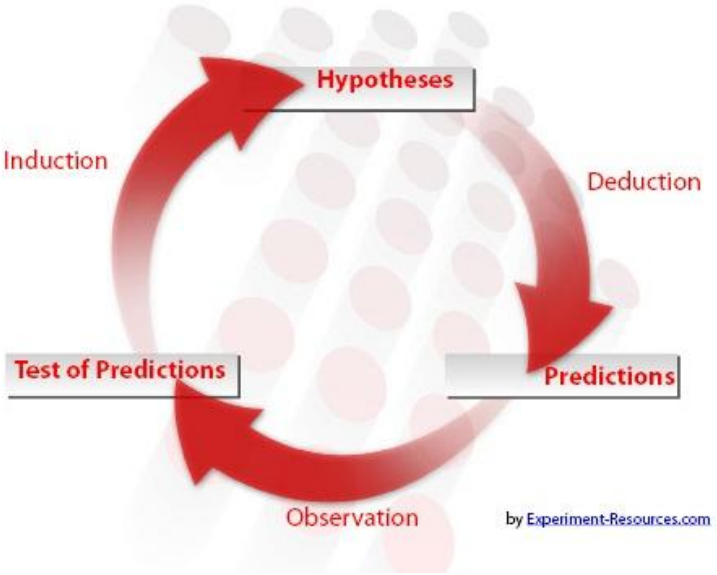
The key to designing any experiment is to look at what research variables could affect the outcome.
There are many types of variable but the most important, for the vast majority of research methods, are
the independent and dependent variables.
A researcher must determine which variable needs to be manipulated to generate quantifiable results.

The independent variable is the core of the experiment and is isolated and manipulated by the researcher. The dependent variable is the measurable outcome of this

manipulation, the results of the experimental design. For manyphysical experiments, isolating the independent variable and measuring the dependent is generally easy. If you designed an experiment to determine how quickly a cup of coffee cools, the manipulated independent variable is time and the dependent measured variable is temperature.

In other fields of science, the variables are often more difficult to determine and an experiment needs a robust design. Operationalization is a useful tool to measure fuzzy concepts which do not have one obvious variable.
The Difficulty of Isolating Variables

In biology, social science and geography, for example, isolating a singleindependent variable is more difficult and any experimental design must consider this.
For example, in a social research setting, you might wish to compare the effect of different foods upon hyperactivity in children. The initial research and inductive reasoning leads you to postulate that certain foods and additives are a contributor to increased hyperactivity. You decide to create a hypothesis and design an experiment, to establish if there is solid evidence behind the claim.



The type of food is an independent variable, as is the amount eaten, the period of time and the gender and age of the child. All of these factors must be accounted for during the experimental design
stage. Randomization andcontrols are generally used to ensure that only one independent variable is manipulated. To eradicate some of these research variables and isolate the process, it is essential to use various scientific measurements to nullify or negate them.
For example, if you wanted to isolate the different types of food as the manipulated variable, you should use children of the same age and gender.

The test groups should eat the same amount of the food at the same times and the children should
be randomly assigned to groups. This will minimize the physiological differences between children. A control group, acting as a buffer against unknown research variables, might involve some children eating a food type with no known links to hyperactivity.
In this experiment, the dependent variable is the level of hyperactivity, with the resulting statistical tests easily

highlighting any correlation. Depending upon the results, you could try to measure a different variable, such as gender, in a follow up experiment.
Converting Research Variables Into Constants

Ensuring that certain research variables
are controlled increases thereliability and validity of the experiment, by ensuring that other causal effects are eliminated. This safeguard makes it easier for other researchers to repeat the experiment and comprehensively test the results.
What you are trying to do, in your scientific design, is to change most of the variables into constants, isolating the independent variable. Any scientific research does contain an element of compromise and inbuilt error, but eliminating other variables will ensure that the results are robust
and valid

- Independent Variable

Independent Variable

The independent variable, also known as the manipulated variable, lies at the heart of any quantitative experimental design.

This is the factor manipulated by the researcher, and it produces one or more results, known as dependent variables. There are often not more than one or two independent variables tested in an experiment, otherwise it is difficult to determine the influence of each upon the final results.
There may be more than several dependent variables, because manipulating the independent can influence many different things.

For example, an experiment to test the effects of a certain fertilizer, upon plant growth, could measure height, number of fruits and the average weight of the fruit produced. All of these are valid analyzable factors, arising from the manipulation of one independent variable, the amount of fertilizer.

Potential Complexities of the Independent Variable

The term independent variable is often a source of confusion; many people assume that the name means that the variable is independent of any manipulation.
The name arises because the variable is isolated from any other factor, allowing experimental manipulation to establish analyzable results.
Some research papers appear to give results manipulating more than one experimental variable, but this is usually a false impression.
Each manipulated variable is likely to be an experiment in itself, one area where the words 'experiment' and 'research' differ. It is simply more convenient for the researcher to bundle them into one paper, and discuss the overall results.

The botanical researcher above might also study the effects of temperature, or the amount of water on growth, but these must be performed as discrete experiments, with only the conclusion and discussion amalgamated at the end.

Independent Variables - Examples

As an example of an experiment with easily defined experimental variables, Mendel's famous Pea Plant Experiment is a good choice.

The Austrian monk cross-pollinated pea plants, trying to establish which characteristics were passed down through the generations. In this case, the inheritable characteristic of the parent plant was the independent variable. For example, when plants with green seedpods were crossed with plants with yellow seedpods, pod color was the independent variable.

In the Bandura Bobo Doll experiment, whether the children were exposed to an aggressive adult, or to a passive adult, was the independent variable.
This experiment is a prime example of how the concept of experimental variables can become a little complex. He also studied the differences between boys and girls, with gender as an independent variable. Surely, this is breaking the rules of only having one manipulated variable!

In fact, this is a prime example of performing multiple experiments at the same time. If you study carefully the structure of the research design, you will see that the Bobo Doll Experiment should have been called the Bobo Doll Experiments.
It was actually four experiments, each with their own hypothesis and variables, running concurrently. It would have been expensive, and possiblyunethical, to test the children four times and, if the same children were used each time, their behavior may have changed with repetition.
Careful design allowed Bandura to test different hypotheses as part of the same research.

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Dependent Variable

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In any true experiment, a researcher manipulates an independent variable, to influence a dependent variable, or variables.

A well-designed experiment normally incorporate one or two independent variables, with every other possible factor eliminated, or controlled. There may be more than two dependent variables in any experiment.

For example, a researcher might wish to establish the effect of temperature on the rate of plant growth; temperature is the independent variable. They could regard growth as height, weight, number of fruits produced, or all of these. A whole range of dependent variables arises from one independent variable.

In any experimental design, the researcher must determine that there is a definite causal link between the independent and dependent variable.

This reduces the risk of 'correlation and causation' errors. Controlled variables are used to reduce the possibility of any other factor influencing changes in the dependent variable, known as confounding variables.

In the above example, the plants must all be given the same amount of water, or this factor could obscure any link between temperature and growth.

The relationship between the independent variable and dependent variable is the basis of most statistical tests, which establish whether there is a real correlation between the two. The results of these tests allow the researcher to accept or reject the null hypothesis, and draw conclusions.