# VARIABLES[*]

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**Abstract**

This module gives definitions and examples of the different types of variables used in psychology
experiments.

## 1 Independent and dependent variables

Variables are properties or characteristics of some event, object, or person that can take on different values
or amounts (as opposed to constants such as $p$ which do not vary). When conducting research, experimenters
often manipulate variables. For example, an experimenter might compare the effectiveness of four types of
antidepressants. In this case, the variable is the "type of antidepressant".

**Definition 1: Independent variable**
When a variable is manipulated by an experimenter

**Definition 2: Dependent variable**
The experiment seeks to determine the effect of the independent variable on relief from depression.
In this example, relief from depression is called a dependent variable.

In general the independent variable is manipulated by the experimenter and its effects on the dependent
variable are measured.

**Example 1**
Can blueberries slow down aging?
A study indicates that antioxidants found in blueberries may slow down the process of aging.
In this study, 19-month old rats (equivalent to 60-year old humans) were fed either their standard
diet or a diet supplemented by either blueberry, strawberry, or spinach powder. After eight weeks,
the rats were given memory and motor tests. Although all supplemented rats showed improvement,
those supplemented with blueberry powder showed the most notable improvement.

1. What is the independent variable? (diet: blueberries or no blueberries)
2. What are the dependent variables? (memory test and motor skills test)

More information on the blueberry study[1]

**Example 2**
Does beta-carotene[2] protect against cancer?

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[†]http://creativecommons.org/licenses/by/1.0
[1]http://www.apa.org/monitor/dec01/blueberries.html
[2]http://psych.rice.edu/online_stat/glossary/beta_carotene.html

Beta-carotene supplements have been thought to protect against cancer. However, a study published in the Journal of the National Cancer Institute suggests this is false. The study was conducted with 39,000 women aged 45 and up. These women were randomly assigned to receive a beta-carotene supplement or a placebo[3] , and their health was studied over their lifetime. Cancer rates for women taking the beta-carotene supplement did not differ systematically from the cancer rates of those women taking the placebo.

1. What is the independent variable? (supplements: beta-carotene or placebo)
2. What is the dependent variable? (occurrence of cancer)

**Example 3**
How bright is right?
An automobile manufacturer wants to know how bright brake lights should be in order to minimize the time required for the driver of a following car to realize that the car in front is stopping and to hit the brakes.

1. What is the independent variable? (brightness of brake light)
2. What is the dependent variable? (time to hit brake)

### 1.1 Levels of an Independent Variable

If an experiment compares an experimental treatment with a control treatment, then the independent variable (type of treatment) has two levels: experimental and control. If an experiment were comparing five types of diets, then the independent variable (type of diet) would have 5 levels. In general, the number of levels of an independent variable is the number of experimental conditions.

## 2 Qualitative and Quantitative Variables

An important distinction between variables is between qualitative[4] and quantitative[5] variables.

**Definition 3: Qualitative variable**
Variables that express a qualitative attribute
**Example**
Some examples of qualitative variables are hair color, eye color, religion, favorite movie, gender, and so on.

The values of a qualitative variable do not imply a numerical ordering. Values of the variable "religion" differ qualitatively; no ordering of religions is implied. Qualitiative variables are sometimes referred to as **categorical variables**. Values on qualitative variables do not imply order, they are simply categories.

**Definition 4: Quantitative variables**
Variables that are measured in terms of numbers.
**Example**
Some examples of quantitative variables are height, weight, and shoe size.

In the study on the effect of diet discussed above (Example 1), the independent variable was type of supplement: none, strawberry, blueberry, and spinach. The variable "type of supplement" is a qualitative variable; there is nothing quantitative about it. In contrast, the dependent variable "memory test" is a quantitative variable since memory performance was measured on a quantitative scale (number correct).

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[3]http://psych.rice.edu/online_stat/glossary/placebo.html
[4]http://psych.rice.edu/online_stat/glossary/qualitative_variable.html
[5]http://psych.rice.edu/online_stat/glossary/quantitative_variable.html

# 3 Discrete and Continuous Variables

Variables such as number of children in a household are called discrete variables[6] .

> **Definition 5: Discrete variable**
> Variable with possible scores of discrete points on the scale.
> **Example**
> A household could have three children or six children, but not 4.53 children.

Other variables such as "time to respond to a question" are continuous variables[7] .

> **Definition 6: Continous variable**
> Variable where the scale is continuous and not made up of discrete steps.
> **Example**
> The response time could be 1.64 seconds, or it could be 1.64237123922121 seconds.

Of course, the practicalities of measurement preclude most measured variables from being truly continuous.

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[6]http://psych.rice.edu/online_stat/glossary/discrete_variables.html
[7]http://psych.rice.edu/online_stat/glossary/continuous_variables.html