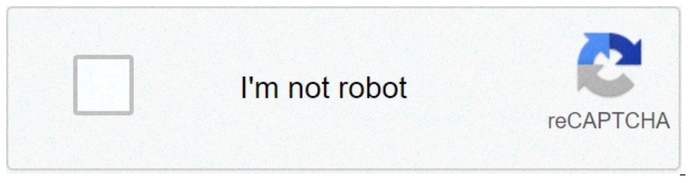

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What is the difference between dependent and independent variables in research

The two main variables in an experiment are the independent and dependent variable. An independent variable is the variable that is changed or controlled in a scientific experiment to test the effects on the dependent variable. A dependent variable is the variable being tested and measured in a scientific experiment. The dependent variable is 'dependent' on the independent variable. As the experimenter changes the independent variable, the effect on the dependent variable is observed and recorded. For example, a scientist wants to see if the brightness of light has any effect on a moth being attracted to the light. The brightness of the light is controlled by the scientist. This would be the independent variable. How the moth reacts to the different light levels (distance to light source) would be the dependent variable. The independent and dependent variables may be viewed in terms of cause and effect. If the independent variable is changed, then an effect is seen in the dependent variable. Remember, the values of both variables may change in an experiment and are recorded. The difference is that the value of the independent variable is controlled by the experimenter, while the value of the dependent variable only changes in response to the independent variable. When results are plotted in graphs, the convention is to use the independent variable as the x-axis and the dependent variable as the y-axis. The DRY MIX acronym can help keep the variables straight: D is the dependent variableR is the responding variableY is the axis on which the dependent or responding variable is graphed (the vertical axis) M is the manipulated variable or the one that is changed in an experimentI is the independent variableX is the axis on which the independent or manipulated variable is graphed (the horizontal axis) The independent and dependent variables are the two key variables in a science experiment. The independent variable is the one the experimenter controls. The dependent variable is the variable that changes in response to the independent variable. The two variables may be related by cause and effect. If the independent variable changes, then the dependent variable is affected. Carlson, Robert. A concrete introduction to real analysis. CRC Press, 2006. p.183. Dodge, Y. (2003) The Oxford Dictionary of Statistical Terms, OUP. ISBN 0-19-920613-9 Everitt, B. S. (2002). The Cambridge Dictionary of Statistics (2nd ed.). Cambridge UP. ISBN 0-521-81099-X. In research, variables are any characteristics that can take on different values, such as height, age, species, or exam score. In scientific research, we often want to study the effect of one variable on another one. For example, you might want to test whether students who spend more time studying get better exam scores. The variables in a study of a cause-and-effect relationship are called the independent and dependent variables. The independent variable is the cause. Its value is independent of other variables in your study. The dependent variable is the effect. Its value depends on changes in the independent variable. Examples of independent and dependent variables Research Question Independent variable(s) Dependent variable(s) Do tomatoes grow fastest under fluorescent, incandescent, or natural light? The type of light the tomato plant is grown under The rate of growth of the tomato plant What is the effect of diet and regular soda on blood sugar levels? The type of soda you drink (diet or regular) How does phone use before bedtime affect sleep? The amount of phone use before bed Number of hours of sleep Quality of sleep How well do different plant species tolerate salt water? The amount of salt added to the plants' water Plant growth Plant wilting Plant survival rate Independent and dependent variables in experiments In experimental research, the independent variable is manipulated or changed by the experimenter to measure the effect of this change on the dependent variable. Experiment exampleYou are studying the impact of a new medication on the blood pressure of patients with hypertension. To test whether the medication is effective, you divide your patients into two groups. One group takes the medication, while the other group takes a sugar pill placebo. Your independent variable is the treatment that you vary between groups: which type of pill the patient receives. Your dependent variable is the outcome that you measure: the blood pressure of the patients. The independent variable is usually applied at different levels to see how the outcome differs. You can apply just two levels (e.g. the new medication and the placebo) in order to find out if the independent variable has an effect at all. You can also apply multiple levels (e.g. three different doses of the new medication) to find out how the independent variable affects the dependent variable. Variables in other types of research Outside of an experimental setting, researchers often cannot directly manipulate or change the independent variable that they're interested in. Instead, they must find already-existing examples of the independent variable, and investigate how changes in this variable affect the dependent variable. Research exampleYou are interested in whether a higher minimum wage impacts employment rates. You can't control the minimum wage yourself. Instead, you look at a state that raised its minimum wage last year, and compare it to a neighboring state that did not. Your independent variable is the minimum wage. Your dependent variable is the employment rate. By comparing the difference in outcomes between the two states (and accounting for other factors), you can investigate whether the change in minimum wage had an effect on employment rates. In non-experimental research, it's more difficult to establish a definite cause-and-effect relationship, because other variables that you haven't measured might be influencing the changes. These are known as confounding variables. In types of research where the exact relationship between variables is less certain, you might use different terms for independent and dependent variables. Other names for independent variables Sometimes, the variable you think is the cause might not be fully independent – it might be influenced by other variables. In this case, one of these terms is more appropriate: Explanatory variables (they explain an event or outcome) Predictor variables (they can be used to predict the value of a dependent variable) Right-hand-side variables (they appear on the right-hand side of a regression equation). Other names for dependent variables Dependent variables are also known by these terms: Response variables (they respond to a change in another variable) Outcome variables (they represent the outcome you want to measure) Left-hand-side variables (they appear on the left-hand side of a regression equation) Scribbr editors not only correct grammar and spelling mistakes, but also strengthen your writing by making sure your paper is free of vague language, redundant words and awkward phrasing. See editing example Visualizing independent and dependent variables Researchers often use charts or graphs to visualize the results of their studies. The norm is to place the independent variable on the "x"or horizontal axis and the dependent variable on the "y" or vertical axis. For instance, how might a graph look from our example study on the impact of a new medication on blood pressure? Frequently asked questions What are independent and dependent variables? You can think of independent and dependent variables in terms of cause and effect: an independent variable is the variable you think is the cause, while a dependent variable is the effect. In an experiment, you manipulate the independent variable and measure the outcome in the dependent variable. For example, in an experiment about the effect of nutrients on crop growth: The independent variable is the amount of nutrients added to the crop field. The dependent variable is the biomass of the crops at harvest time. Defining your variables, and deciding how you will manipulate and measure them, is an important part of experimental design.

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