

# What are the levels of an independent variable?

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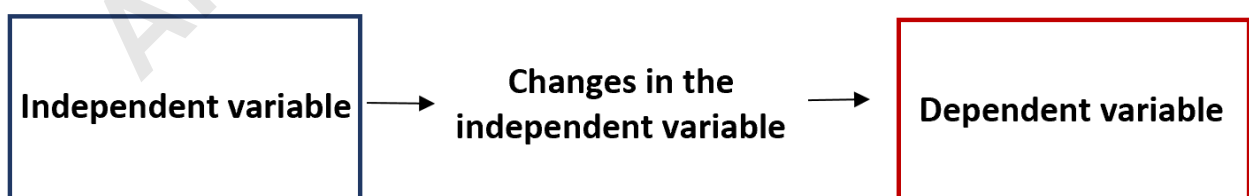
The levels of an independent variable refer to the different values or categories that it can take on in a study or experiment. This variable is independent because it is not affected by other variables and can be manipulated by the researcher. The levels of an independent variable are important to identify and control in research as they can greatly impact the outcome of the study. By varying the levels of the independent variable, researchers can observe how the dependent variable, which is affected by the independent variable, responds. This allows for a better understanding of the relationship between the two variables and helps to draw accurate conclusions. Therefore, the levels of an independent variable play a crucial role in the design and execution of a study.

## What Are Levels of an Independent Variable?

**In an experiment, there are two types of variables:**

**The independent variable:** The variable that an experimenter changes or controls so that they can observe the effects on the dependent variable.

**The dependent variable:** The variable being measured in an experiment that is "dependent" on the independent variable.



**In an experiment, a researcher wants to understand how changes in an independent variable affect a**

**dependent variable.**

**When an independent variable has multiple experimental conditions, we say that there are levels of the independent variable.**

**For example, suppose a teacher wants to know how three different studying techniques affect exam scores. She randomly assigns 30 students each to use one of the three studying techniques for a week, then each student takes the exact same exam.**

**In this example, the independent variable is Studying Technique and it has three levels:**

**Technique 1 Technique 2 Technique 3**

**In other words, there are the three experimental conditions that the students can potentially be exposed to.**

**The dependent variable in this example is Exam Score, which is "dependent" on the studying technique used by the student.**

**The following examples illustrate a few more**

**experiments that use independent variables with multiple levels.**

#### **Example 1: Advertising Spend**

**Suppose a marketer conducts an experiment in which he spends three different amounts of money (low, medium, high) on TV advertising to see how it affects the sales of a certain product.**

**In this experiment, we have the following variables:**

**Independent Variable: Advertising Spend**

**3 Levels: Low Medium High**

#### **Example 2: Placebo vs. Medication**

**Suppose a doctor wants to know if a certain medication reduces blood pressure in patients. He recruits a of 100 patients and randomly assigns 50 to use a pill that contains the real medication and 50 to use a pill that is actually just a placebo.**

**In this experiment, we have the following variables:**

**Independent Variable: Type of Medication**

**2 Levels: True medication pill Placebo pill**

**Dependent Variable: Overall change in blood pressure**

**Example 3: Plant Growth**

**Suppose a botanist uses five different fertilizers (We'll call them A, B, C, D, E) in a field to determine if they have different effects on plant growth.**

**In this experiment, we have the following variables:**

**Independent Variable: Type of fertilizer**

**5 Levels: Fertilizer A Fertilizer B Fertilizer C Fertilizer D Fertilizer E**

**Dependent Variable: Plant growth**

**How to Analyze Levels of an Independent Variable**

**Typically we use a to determine if the levels of an independent variable cause different outcomes in a dependent variable.**

**A one-way ANOVA uses the following null and alternative hypotheses:**

**H0 (null): All group means are equal**  
**H1 (alternative): At least one group mean is different from the rest**

For example, we could use a one-way ANOVA to determine if the five different types of fertilizer in the previous example lead to different mean growth rates for the plants.

If the p-value of the ANOVA is less than some significance level (e.g.  $\alpha = .05$ ), then we can reject the null hypothesis. This means we have sufficient evidence to say that the mean plant growth is not equal at all five levels of the fertilizer.

We could then proceed to conduct to determine exactly which fertilizers lead to different mean growth rates.