

## Translating a research question into a testable hypothesis

The first thing is to make sure your question is simple, as opposed to compound (i.e. one single question that does not have multiple parts).

For example: Does milling affect particle size and what is the optimal particle size?

is a compound question, it has two parts

- 1) Does milling effect particle size
- 2) What is the optimal particle size

Part 1 is a simple question and it is testable.

You should also have a clear idea of what your OUTCOME is: the “phenomenon” you are studying, trying to examine, trying to learn more about, change, etc.

**AND** you should have a clear idea of how you are going to measure it: what instrument you are going to use and what it means...this requires that you have a clear definition of the “outcome”.

Outcomes are often referred to as the DEPENDENT variable:

In this example, Particle size is the outcome and we want to know how it is affected by milling.

Milling is defined as the independent variable....so we are asking if

The independent variable (IV) affects the dependent variable (DV\outcome)....

if particle size is a continuous measure and milling is a “process” i.e. milled or not milled... something (a treatment) that is applied\used OR not

then you could measure two groups of particles...some that are the result of milling and some that are not and the average particle size for each can be compared using a t-test:

The testable hypothesis is:

The mean particle size from milling is equal to the mean particle from no milling?

A two part (compound) question is different than asking a more complex question that still has one idea like

Does milling AND\OR coating type effect particle size?

This would require a Two-way ANOVA to test the effect of two independent variables (Milling & Coating type) and a possible interaction between them. (Let’s say there are 3 types of coating)!

A two-way ANOVA actually tests three hypotheses at once:

- 1) The mean particle size from milling is equal to the mean particle from no milling?
- 2) The mean particle size from coating type A is equal to the mean particle from coating type B is equal to the mean particle size from coating type C?
- 3) Is there an interaction between milling and coating type?

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