

Experiments and Observational Studies

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February 16, 2018

Goal: identify causal associations

- Establish whether there is a link between an **explanatory variable** and a **response variable**
- Does changing the value of the explanatory variable **cause** the value of the response variable to change?
- Example:
 - peanut consumption or avoidance is **explanatory variable**
 - peanut allergy is **response variable**

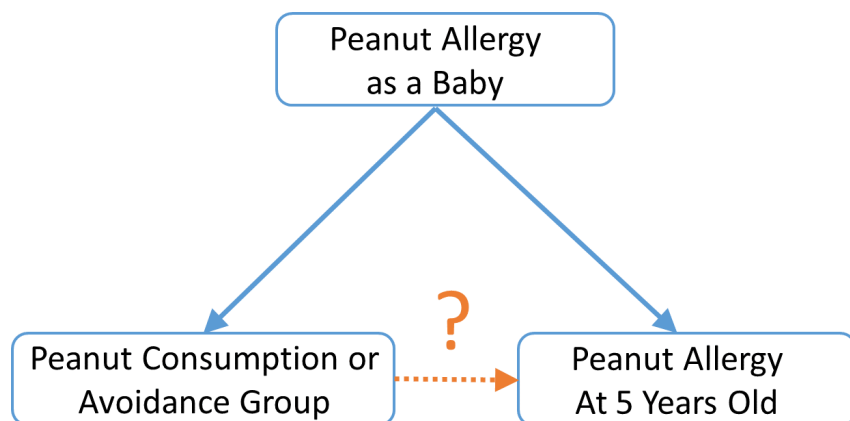
2 Types of Studies

1. **Experiments:** The explanatory variable(s) are controlled by the researcher (and the researcher randomly assigns the value of the explanatory variable to each subject).
 - Researcher assigns babies to the peanut consumption or peanut avoidance groups
 2. **Observational studies:** the explanatory variable(s) are not manipulated or controlled by the researcher.
 - Babies either end up consuming peanut or avoiding peanuts, for reasons outside of the researcher's control.
- To demonstrate a **causal** relationship, need to run an **experiment**.

Confounding

- A **confounder** is a variable that is associated with both the explanatory variable and the response variable, but is not in the 'causal pathway'.

Example: Suppose we let families choose whether their child is in the peanut consumption group or the peanut avoidance group...



Four Principles of Experimental Design

Goal: Prevent/Limit Confounding

- **Control:** Control sources of variation other than the factors we are testing by making conditions as similar as possible for all treatment groups.
 - If you give children in the peanut consumption group allergy medicine, also give it to children in the peanut avoidance group
- **Randomization:** Subjects/experimental units are assigned to treatments at random to equalize the effects of unknown or uncontrollable sources of variation.
- **Replication:** Each treatment is applied to more than one subject/experimental unit.
- **Blocking:** Group together subjects/experimental units that are similar in important ways that you cannot control, then randomize the assignment of treatments within each of these groups, or blocks.
 - Block according to initial allergy test results.

What to do in Observational Studies??

We can't do control or randomization or blocking!!

- **Matching:** Find study participants who:
 - have different levels of the explanatory variables of interest, but
 - are similar in ways that are not directly being studied
 - compare values of the response variable between these matched participants.

This is the closest to blocking/randomization that you can get in an observational study.