

4.2 Experiments

An observational study observes individuals and measures variables of interest but does not attempt to influence the response.

An experiment deliberately imposes a treatment on individuals to measure their response

* an experiment, by imposing a treatment, is the only way to show a cause and effect relationship between 2 variables.

Confounding: occurs when 2 variables are associated in such a way that their effects on the response variable can't be distinguished from each other.

EX: An increase in ice cream sales shows a very strong negative association with the # of cases of the flu. Is ice cream a cure for the flu? Explain.

When the temperatures are high, there is also an increase in ice cream. A better explanation for a decrease in flu cases is the warmer temperatures.

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- ① Experiment, a treatment, brightness of the screens was imposed on the individuals.
- ② Observational study, there is no treatment imposed.
- ③ Explanatory: # times they ate dinner w/ family
Response: Academic performance
- ④

Language of Experiments

Treatment: a specific condition applied to individuals in an experiment.

Experimental Units: smallest collection of individuals to which treatments are applied.
• called subjects if experimental units are humans.

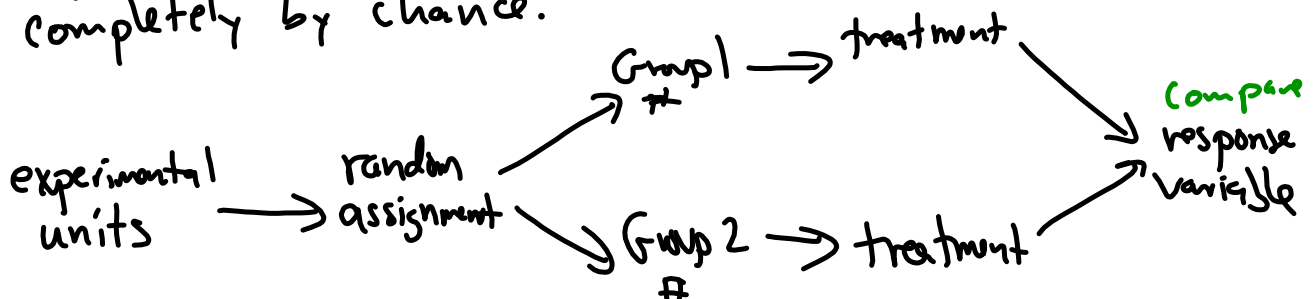
factor: explanatory variable, typically when there is more than 1 being tested.

Principles of Experimental Design

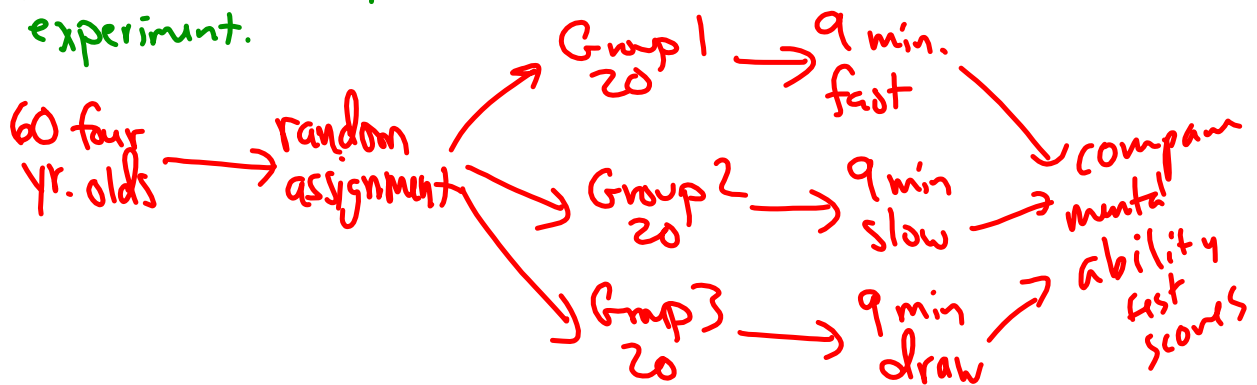
- ① Comparison: uses a design to compare 2 or more treatments
- ② Random Assignment: uses chance to assign treatments so groups are roughly equivalent.
- ③ Control: keep other variables that might effect the response the same for all groups.
- ④ Replication: use enough subjects to distinguish a difference in the effects of the treatments from chance variation due to random assignment.
replication ≠ repeatability

Completely Randomized Experiment

experimental units are assigned to treatments completely by chance.



Ex: Psychologists want to know how different types of TV shows impact young children. They recruit 60 four yr. olds and have them watch 9 minutes of fast paced programming, 9 minutes of slowed paced program, or have them draw for 9 minutes. After 9 minutes, a child completes a mental ability test. Describe a completely randomized experiment.



We will randomly assign 60 four olds to 3 groups of 20 kids each. Group 1 watches 9 min. of fast paced programming, group 2 watches 9 min. of slow paced programming, and group 3 draws for 9 min. We will then give a mental ability test and compare the results.

Control Group: a group who does not receive a treatment.
Typically used for a baseline for comparing the effects of the other treatments.

Ex: What was the control group of the previous example?

Group 3, drawing for 2 minutes.

Problems with experiments

1. Placebo Effect: a response to a placebo (fake treatment)

* In the Physician Health example, if no pill was given instead of a placebo, the effect of beta carotene or aspirin would be confounded with the placebo effect.

2. Lack of Blinding: subjects and experimenters know who is getting the treatment and therefore can get biased results.

double blind: neither the researcher nor the subject know which treatment a subject receives.

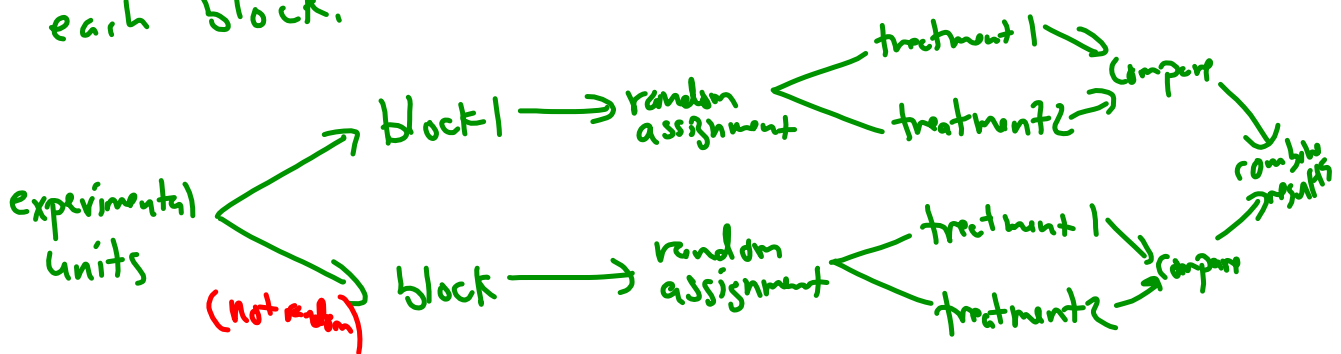
single blind: research or the subject does not know a treatment a subject receives.

Statistically significant: an observed effect so large, it would rarely occur by chance.

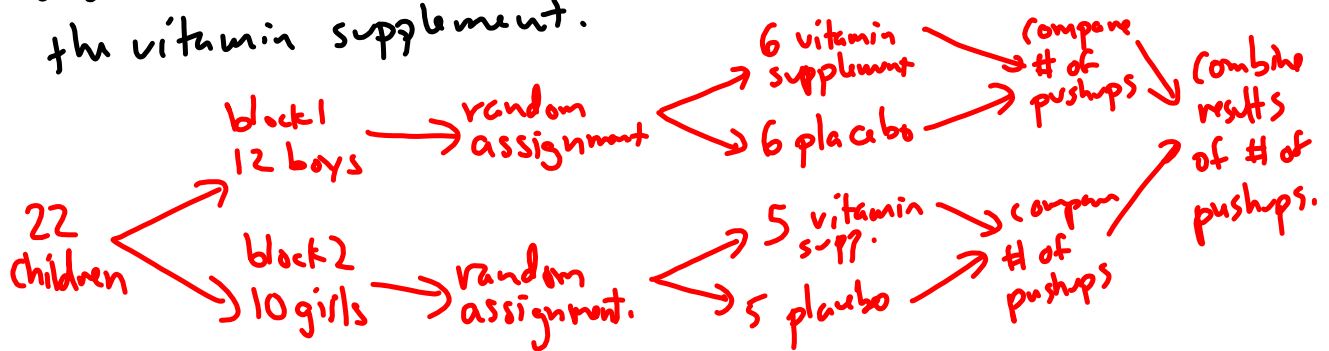
Blocking

Block: Group of experimental units that are known, before the experiment, to be similar in some way that is expected to systematically affect the response to the treatments.

Randomized Block Experiment: the random assignment of experimental units is carried out separately within each block.



Ex: 12 boys and 10 girls are recruited to test how a vitamin supplement affects the number of pushups that can be done. Draw an outline and describe an experiment to test the effectiveness of the vitamin supplement.



We will split the 22 children into blocks of 12 boys and 10 girls because we expect the # of pushups to be different by gender. We will randomly assign 6 boys to vitamin supplement or a placebo and the same with 5 girls. We will then compare the number of pushups within each block, and then combine the results.

"Control what you can, block what you can't,
and
randomize for comparable groups"

Matched Pairs Design

type of randomized block design with blocks of size 2.

- ① Each subject can receive both treatments
* in a random order.
- ② Two similar subjects can randomly receive a treatment

Ex: Hear no evil, see no evil example in the beginning of chapter. Explain why a matched pairs design would have been preferable.

A matched pairs where the subject performs both tests may have been preferable since there are different learning styles where one may do better than others