

# AP Statistics

## 2019-01-10 Section 4.2 Experiments, Continued

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### Warm-up

A study of child care enrolled 1364 infants and followed them through their sixth year in school. Later, the researchers published an article in which they stated that "the more time children spent in child care from birth to age four-and-a-half, the more adults tended to rate them, both at age four-and-a-half and at a kindergarten, as less likely to get along with others, as more assertive, as disobedient, and as aggressive."

1. Is this an observational study or an experiment? Justify your answer.

This is observational, as the researchers did not change anything, only observe.

2. Does this study show that child care causes children to be more aggressive? Explain.

Cause-and-effect can only be demonstrated by experiments.

### Three principles of experimental design

**Controls** helps find lurking variables that may affect the response. Proper design ensures that lurking variables are accounted for and minimized.

**Random Assignment:** use impersonal (random) chance to assign experimental units to treatments

**Replication:** use enough experimental units in each group so that any differences in treatments can be distinguished from the groups.

**Double-blind** experiments help ensure that all parts of the trial. In this case, neither the subjects nor those who interact with them know what occurs, therefore, any unconscious biases or changes in interaction can be excluded.

### Example

In an interesting experiment, researchers examined the effect of ultrasound on birth weight. Pregnant women participating in the study were randomly assigned to one of two groups. The first group of women received an ultrasound; the second group did not. When the subjects' babies were born, their weights were recorded. The women who received the ultrasounds had heavier babies.

This experiment does not take the placebo effect into account as the patient knows whether or not they received an ultrasound. This experiment was not double-blind as the patients were aware of what they experienced.

This could be fixed and made double-blind if fake ultrasounds were used on certain patients without their or the doctors' knowledge.

Researchers hope to find enough of a difference in experiments so that it is unlikely to have happened because of chance variation (**statistically significant**)

Statistically significant results from a well-designed experiment **does** imply causation.

A block is a group of experimental units that are known before the experiment to be similar in some way that is expected to respond differently.

In a **randomized block design**, the assignment of experimental units to treatments is done separately within each block.

For example, a trial may test the effectiveness of a certain detergent on clothes.

Light and dark clothes would be separated before being treated as they would normally.

Block are another form of control, where certain variables are able to be controlled for although they vary across the sample.

Separate conclusions can then be drawn from each block, allowing more precise overall conclusions.

*Control what you can, block what you can't.*

A common type of randomized block design is **matched pairs design**, where pairs of similar units are created.

Chance is then used within each pair to determine which of the pair gets the first treatment and which gets the other treatment.

This helps reduce the effect of variation among units.