

- a. Which characteristic(s) of a well-designed experiment was (were) missing in Problem 1 in the mung bean seed study of:

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- b. Which characteristic of a well-designed experiment, if any, were missing from your penny-stacking experiment?

- c. What can go wrong if treatments are not assigned randomly to subjects?

3. In 1954, a huge medical experiment was carried out to test whether a newly developed vaccine by Jonas Salk was effective in preventing polio. Over 400,000 children participated in the portion of the study described here. Children were randomly assigned to one of two treatments. One group received a placebo (an injection that looked – and felt – like a regular immunization but contained only salt water). The other group received an injection of the Salk vaccine.

- a. What are the treatments in the Salk experiment? What is the response variable?

Treatments - Vaccine or Salt water

Response Variable

Whether the child was diagnosed with Polio or not

- b. Did the test of the Salk vaccine have the three characteristics of a well-designed experiment?

4. Many difficulties in testing the Salk vaccine had been anticipated. Which of the three characteristics of a well-designed experiment helped overcome each difficulty described below? Explain.

a. The incidence of polio was very low, even without immunization.

Large number of subjects

b. The vaccine was not expected to be 100% effective.

Control Group

c. One possible approach would have been to immunize all children in the study and compare the incidence of polio to that of children the same age the previous year. However, the incidence of polio varied widely from year to year.

Random Assignment

d. One possible experiment design would have been to let parents decide whether their child was vaccinated and compare the rates of polio of the vaccinated and unvaccinated children. In the United States, polio was primarily a disease of children from middle- and upper- income families and so those children's parents are specially anxious to get them vaccinated.

Random Assignment

5. Many studies have shown that people tend to do better when they are given special attention or when they believe that they are getting competent medical care. This is called the placebo effect. Even people with post-surgical pain report less discomfort if they are given a pill that is actually a placebo (a pill containing no medicine) but which they believe contains a painkiller. One way to control for the placebo effect is to make the experiment **subject blind**, the person receiving the treatment does not know which treatment he or she is getting. That is, the

subjects in both treatment groups appear to be treated exactly the same way.

In an **evaluator-blind** experiment, the person who evaluates how well the treatment works does not know which treatment the subject received. If an experiment is both subject blind and evaluator blind, it is called a **double blind**.

a. The Salk experiment was double blind. One reason this was necessary was because the diagnosis of polio is not clear-cut. Cases that cause paralysis are obvious, but they are the exception. Sometimes polio looks like a bad cold and so professional judgement is needed. How might a doctor's knowledge of whether or not a child had been immunized affect his or her diagnosis? How might this lead to the wrong conclusion about how well the vaccine works?

b. Could you make the penny-stacking experiment subject blind? Evaluator Blind? Double Blind? Explain

6. A lurking variable helps to explain the association between the treatments and the response but is not the explanation that the study was designed to test. Treatments are assigned randomly to subjects to equalize the effects of possible lurking variables among the treatment groups as much as possible. Analyze each of the following reports of studies with particular attention to possible lurking variables.

a. Researchers from the Minnesota Antibiotic Resistance Collaborative reported an attempt to deal with the problem that bacteria are becoming resistant to antibiotics. One reason for increasing resistance is that some people want antibiotics when

they have a cold, even though cold viruses do not respond to antibiotics.

Five medical clinics distributed colorful kits containing Tylenol decongestant, cough syrup, lozenges, powdered chicken soup, and a tea bag to patients with cold symptoms. At five other medical clinics, patients with similar symptoms were not given these kits. Patients with colds who visited clinics that made the kits available were less likely to fill prescriptions of antibiotics than patients with colds who visited clinics where the kits were not available.

i. What are the treatments in the study? What is the response variable? *Treatment Kit vs No Kit*

ii. Why is this not a well-designed experiment? How could you improve it?
R.V. Fill prescription

No Random Assignment

iii. What lurking variable might account for the difference in responses? *Dr Attitude towards prescript*

Age

Cost to Fill prescrip.

b. Researchers supplied 238 New York City households with hand-washing soaps, laundry detergents, and kitchen cleansers. Half of the households, selected at random, were given antibacterial products, and the other half received products that were identically packaged but without the antibacterial ingredient.

The participants were asked weekly about any disease in the household. The researchers found no differences in frequency of infectious disease symptoms over one year.

i. Does this study have the three characteristics of a well-designed experiment?

ii. Suppose that instead of assigning the treatments at random to the households, the researchers simply compare the frequency of infectious disease symptoms one a year in households that use the antibacterial products and those that do not. Describe lurking variables that might invalidate the conclusion of the study.