G2 - Scientific Questions

HCI/PSYCH 522
Iowa State University

March 1, 2022

Scientific questions vs scientific hypotheses

https://study.com/academy/lesson/how-to-evaluate-scientific-questions.html

Definition

A scientific question is [a question] where [a study] can be designed and completed to find out the answer (without having to do multiple, entirely different investigations to get there).

https://study.com/learn/lesson/scientific-hypothesis-development-examples.html

Definition

A scientific hypothesis is a testable, clear statement, about what you think will happen in a [study], based on your observations and prior knowledge.

Scientific questions

https://study.com/academy/lesson/how-to-evaluate-scientific-questions.html

Definition

A scientific question is a question that is written in a way that is helpful for completing scientific investigations. A scientific question is one where an investigation can be designed and completed to find out the answer without having to do multiple, entirely different investigations to get there. In a word, a scientific question is testable.

Definition

A testable question is one that asks about objects, organisms, or events found in the world around us. It can be answered through experiment, observation, or other data collection by analyzing measurable data and evidence. And a testable question is one based on scientific ideas, not opinions, morals or other subjective things. The answer should be objective and clear.

Closed vs open questions

https://www.arlingtonresearch.global/insights/what-is-the-difference-between-a-closed-and-open-question-in-research/

Definition

A closed question is simply one that the participant can answer 'yes' or 'no' to. An open question requires far more detail, and invites the person responding to provide information into how they feel and what they think about a subject.

Prefer open scientific questions to closed scientific questions:

- Closed: Does computer brand affect efficiency?
- Open: How does computer brand affect efficiency?

Everything affects everything. Thus it is not a question of if, but a question of how much.

Bad scientific questions

- Why do humans use computers?
- How do trackpads differ from mice?
- How does communication affect online ordering accuracy?
- Do blue light glasses affect frequency of headaches?
- ⋮

Good (better?) questions

- How is typing speed affected by DVORAK vs QWERTY keyboards after 2 years of continuous use?
- How do finger size and touchscreen keyboard size affect typing accuracy on an iPhone amongst 18-45 year old users in the US?
- How does the use of blue light glasses affect headache frequency, duration, and severity?
- ⋮

Best (?) questions

Include the following

- Population
- Treatment (if applicable)
- Method of measurement

For example,

- How do Activity 2 (binomial) homework scores amongst students in HCI 522 Spring 2022 compare amongst those who used R vs those who used Excel?
- What is the mean score on `http://mouseaccuracy.com` (normal, medium, 30 seconds) of students in the eSports club at Iowa State University?

Scientific hypotheses

https://study.com/learn/lesson/scientific-hypothesis-development-examples.html

Definition

A scientific hypothesis is the first step in the scientific method, and is often defined as an educated guess. The definition of a scientific hypothesis can be much more detailed than this, however. A scientific hypothesis is a testable, clear statement, about what you think will happen in a science experiment, that is based on your observations and prior knowledge. A scientific hypothesis should be written before an experiment takes place, so that you can determine if your experiment supports, or refutes, your hypothesis. A well-written hypothesis can be easily supported or refuted, based on the results of an experiment.

Null hypotheses

Definition

A null hypothesis is a statement that two parameters are the same.

For example

- two probabilities are equal,
- two means are equal, or
- regression slope is zero.

Generally, nobody believes null hypotheses and therefore they are straw men that will be rejected with enough data.

Alternative hypothesis

Definition

An alternative hypothesis is the opposite of the null hypothesis.

For example

- two probabilities are not equal,
- two means are not equal, or
- regression slope is not zero.

Generally, the scientist performing the study believes the alternative.

Working hypothesis

https://www.merriam-webster.com/dictionary/workinghypothesis

Definition

A working hypothesis is a hypothesis adopted as a guide to experiment or investigation or as a basis of action.

For example,

- using a DVORAK keyboard will increase typing speed,
- increasing mouse sensitivity will decrease clicking accuracy, and
- auto-spellcheckers will increase texting speed.

This hypothesis is used as the basis to create a study: observational or experimental.

Confirmation bias

https://journals.sagepub.com/doi/10.1037/1089-2680.2.2.175

Definition

Confirmation bias ... connotes the seeking or interpreting of evidence in ways that are partial to [an] existing ... hypothesis .

https://www.nytimes.com/interactive/2015/07/03/upshot/a-quick-puzzle-to-test-your-problem-solving.html

You should strive to disprove your hypothesis and understand why.

Group Project Research Question

The question should be

- specific,
- answerable using quantitative data, and
- answerable in the time frame available.