

## Questions and Answers for the Lectures on HCI

### Module 5

1. What is empirical research? What is the appropriate research question in the context of empirical research? Explain the types and importance of validity of research questions?

**Answer:** Empirical research is broadly defined as the observation-based investigation seeking to discover and interpret facts, theories, or laws. In simple terms in the context of HCI, it is about evaluating a design with users.

In empirical research, research questions are asked. However, it is not only necessary to raise research questions, but to raise “testable” research questions, for which we can actually conduct experiments.

There are two types of validity of a research question: internal validity and external validity. The extent to which the observations made are due to the test conditions is called internal validity of the research question. The extent to which results are generalizable to other people and other situations is known as the external validity of the research question.

2. Discuss the different types of measurement techniques. Why ratio measurement is preferable?

**Answer:** There are broadly four scales of measurements that are used:

- a) Nominal: here, we assign some (arbitrary) codes to attributes of observational data (for example, male = 1, female = 2 etc.).
- b) Ordinal: in this scale of measurement, the observations are ranked (for example, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> etc.).
- c) Interval: in interval measurement, we consider equally spaced units but no absolute starting point (for example, 20° C, 30° C, 40° C, ...)
- d) Ratio: this scale of measurement has an absolute starting point (zero) and uses ratios of two quantities (for example, 20 WPM, 30 CPS etc.).

Ratio scales are the most preferred scale of measurement, because ratio scales make it convenient to compare or summarize observations.

3. Discuss the key steps associated with experiment design.

**Answer:** An experiment design involve deciding on the following items.

- a) Who are the participants and how to get them.
  - b) What should be the dependent and independent variables. What are the levels (test conditions) of the independent variables.
  - c) What are the control variables.
  - d) How to take care of the confounding variables (i.e., variables that are not considered but which might affect the outcome).
  - e) If the experiment should be within-subject (i.e., each participant tested on all levels) or between-subject (i.e., each participant tested on a single level).
4. What is the significance of counterbalancing? Mention a method to achieve counterbalancing in experiment design.

**Answer:** For within-subject (repeated measure) experiment designs, participants' performance may tend to improve with practice as they progress from one level to the next. Thus, participants may perform better on the second level simply because they benefited from practice on the first. This is undesirable as it leads to observations that do not correspond to the actual user behavior. To compensate, the order of presenting conditions is counterbalanced.

A method to counterbalance is to present the test conditions to the participants following a Latin square (for more details, see slides 24-26, Lecture 2, Module 5).

5. Discuss the significance of statistical data analysis in empirical research.

**Answer:** When we analyze empirical data collected from a set of participants, we get some results. On the basis of the results, we draw conclusions about the system under investigation. However, the analysis of the empirical data may not necessarily lead to the right conclusions. This is because we collect data from a set of participants, who represent a small sample of the potential group of users. Consequently, it may happen that the observations we make are *by chance*, which may change if we collect data from a different group of participants. In order to know if the results observed are by chance or not, we can take recourse to statistical data analysis techniques such as ANOVA (Analysis Of VAriance).