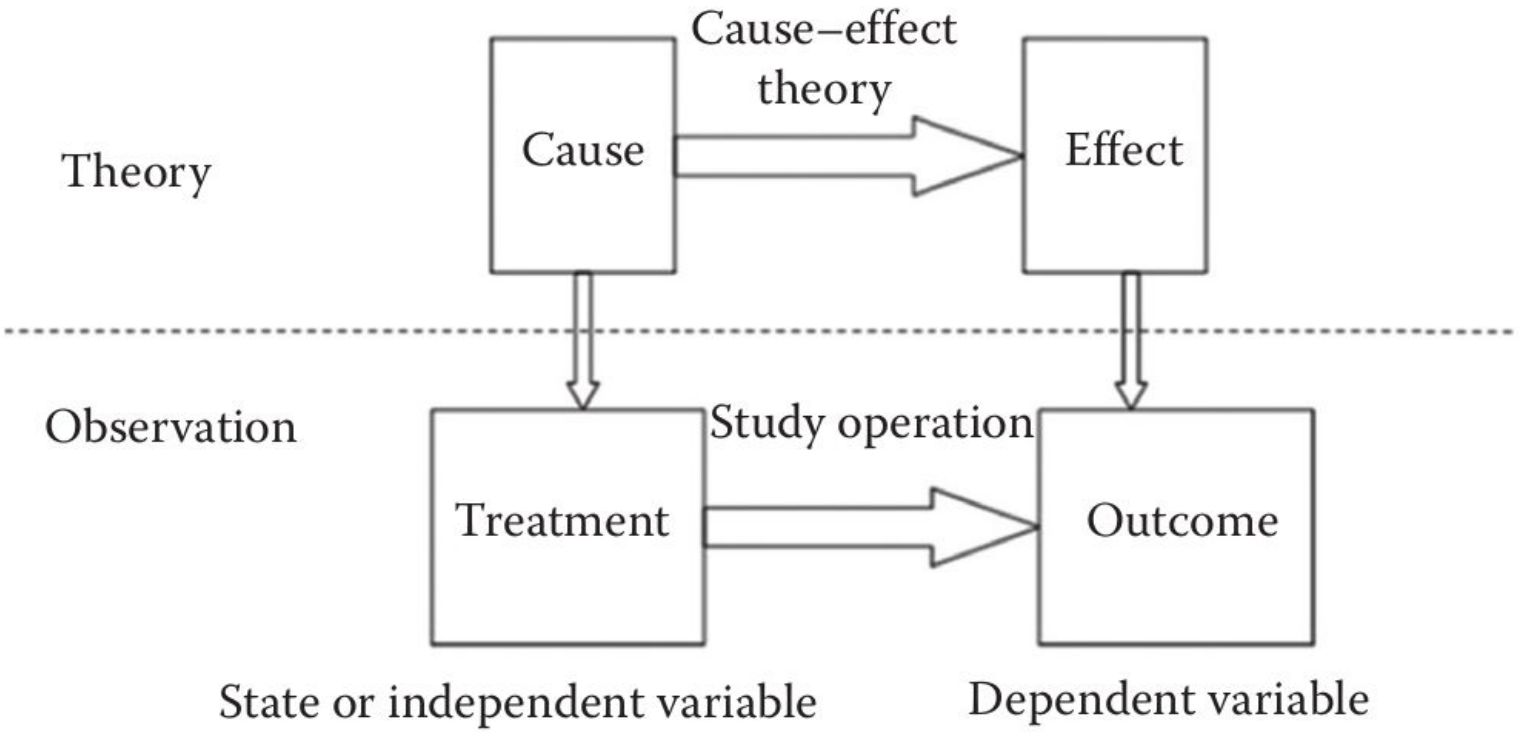
Empirical Study

Empirical Study

- A theory is developed to explain a phenomenon and predict some consequences
- Empirical studies are conducted to test the theory
- Empirical studies do not prove that a theory is true. Rather, they provide further evidence to support or refute the theory

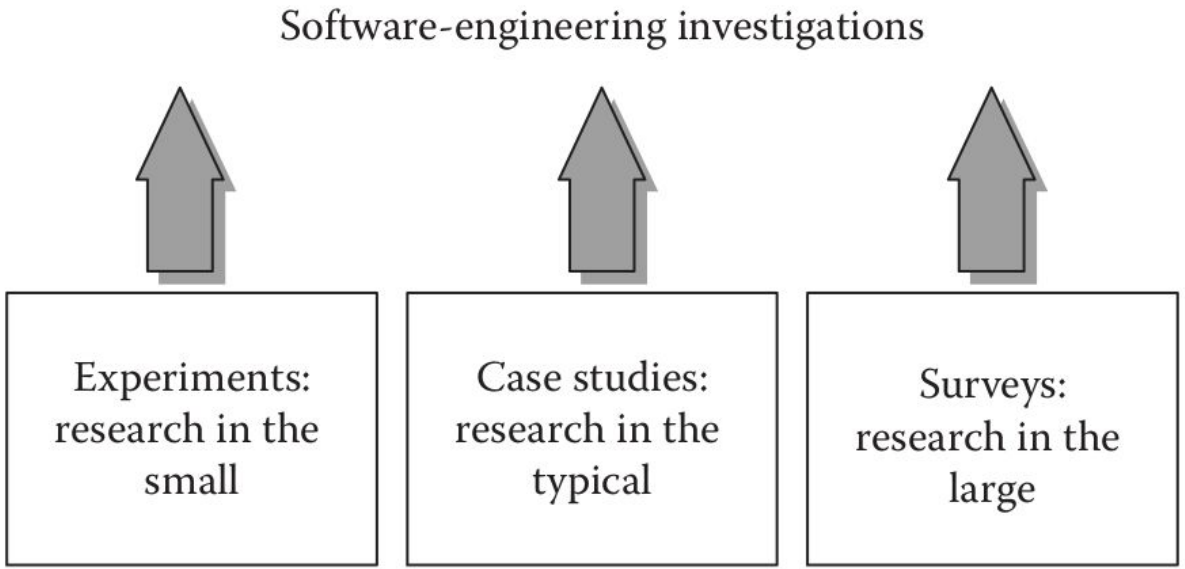
Empirical Studies



Key Principles to Consider

- The level of control of study variables that determines the appropriate type of study
- Study goals and hypotheses
- Maintaining control of variables
- Threats to validity
- The use of human subjects

Control of Variables and Study Type



Experiments : Research in the Small

- Controlled experiments involve the testing of **well-defined hypotheses** concerning postulated effects of **independent variables** on **dependent variables** in a setting that **minimizes other factors that might affect the outcome**
- experiments require a great deal of control, they tend to involve small numbers of people or events
- Controlled experiments tend to be conducted in academia or research labs
- Rarely performed inside software industrial environment as controlling for confounding factors is hard

Case Studies : Research in the Typical

- Empirical studies that involve observations where potential confounding variables **cannot be controlled** and/or subjects **cannot be assigned to treatment or control groups** are called observational studies, natural experiments, and/or quasi-experiments
- Empirical studies in software engineering are case studies that involve the use of a tool or technique on projects without random assignment of subjects to projects and control of all other variables
- Experiments are controlled, case studies are observational data collection and study

Experiments vs Case Studies

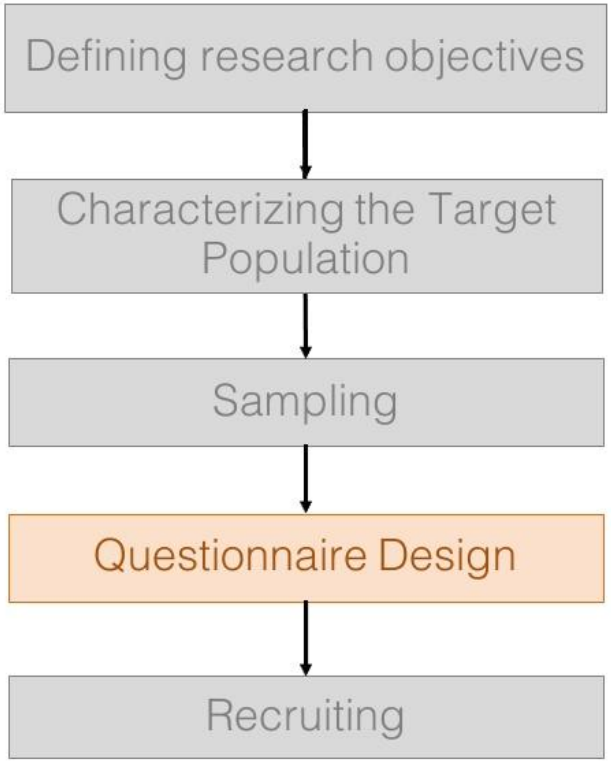
TABLE 4.1 Factors Relating to Choice of Research Technique

Factor	Experiments	Case Studies
Level of control	High	Low
Difficulty of control	Low	High
Level of replication	High	Low
Cost of replication	Low	High

Survey : Research in the Large

- A survey is a retrospective study of a situation to try to document relationships and outcome
- A survey is done after an event has occurred

Best Practices



Questionnaire Design

Challenge:

To design a clear, simple and consistent survey questionnaire

Remember:

Bad questionnaires can led subjects initially willing to participate to give up!

Questionnaire Design

Challenge:

To design a clear, simple and consistent survey questionnaire

- Use simple and appropriate wording for the survey questions
- Avoid technical terms as much as possible or define them in the questionnaire, according to the survey target population
- Take preference to design short questions **regarding a single concept**
  - Avoid double barreled questions
- Avoid vague sentences while writing survey questions

Image source: http://www.fooj.it/wp-content/uploads/2015/07/boring-office.jpg

Questionnaire Design

In your opinion, do you agree or disagree that code refactoring is a need? And what about code smell detection?

a) I strongly agree
b) I partially agree
c) I agree
d) I disagree

Questionnaire Design

Code refactoring is an essential practice for improving the understanding of object-oriented code.

a) Totally agree
b) Partially agree
c) Neither agree nor disagree
d) Partially disagree
e) Totally disagree

Questionnaire Design

Challenge:

To design a clear, simple and consistent survey questionnaire

- Avoid biased questions, which can be done by carefully phrasing the questions that do not suggest likely answers or responses
- Avoiding sensitive questions
  - In SE context, the sensitive questions can be about respondents income, opinion about organization or management, etc.
- Avoid to ask about far past events

Questionnaire Design

Do you prefer working in projects following agile methods or those following usual non-agile approaches?

Considering the main characteristics of the last 10 software projects you have worked on, please answer the following questions:

Asking *age, gender, marital status* for characterizing requirements engineers

Questionnaire Design

Challenge:

To design a clear, simple and consistent survey questionnaire

- It is important to avoid demanding questions (requiring too much effort from respondents to answer)
- Avoid double negatives

Questionnaire Design

After reading the attached papers regarding non functional requirements (NFR), please answer the following questions:

1. Which of the following NFR do you disagree are not relevant in the context of real-time systems?

…

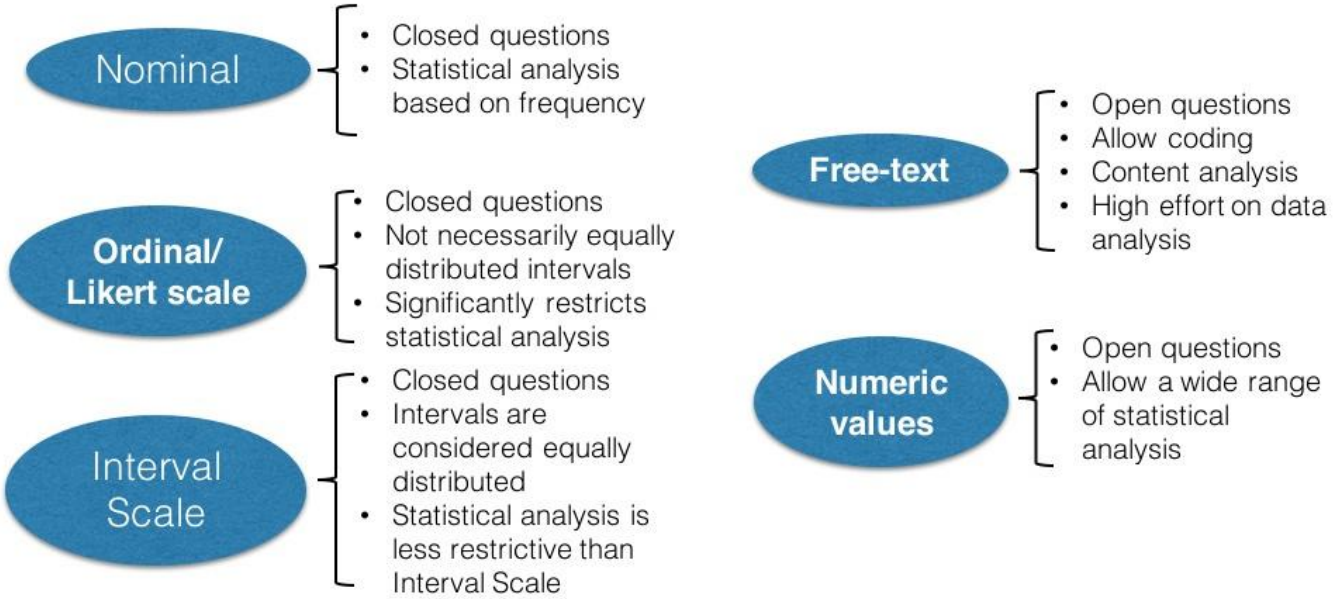
Questionnaire Design

Challenge:

To design a clear, simple and consistent survey questionnaire

- Be careful on selecting the Response Format!
- Wrong choices of response format may lead you to:
  - Lose precious data
  - Lose the opportunity of applying relevant statistical tests
  - Significantly (and unnecessarily) increase data analysis efforts

Questionnaire Design



Questionnaire Design

Do you have experience in Java programming?

( ) Yes ( ) No

How much experience do you have in Java programming?

__5__ years

How much experience do you have in Java programming?

a) Very High experience
b) High Experience
c) Few Experience
d) Very Few experience

How much experience do you have in Java programming?

I have been working with Java programming at companies since 2011. Before, I got my first Java certification in 2009, when I started working in personal projects. But I have difficult with object-oriented parts...

How much experience do you have in Java Programming?

a) Less than one year
b) 1 year to 3 years
c) 3 years to 5 years
d) More than 5 years