ESSENTIAL

Evolving Security SciencE through Networked Technologies, Information policy And Law

Psychological Science Research Methods #2

Contains material from:
Beins (2009). Robinson-Riegler & Robinson-Riegler (2008); Ray 4e (1993); Graziano & Raulin 2e (1993)

Noellie Brockdorff
University of Malta

Malta Summer School, July 2018

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Session Plan

i. Quantitative or qualitative? A brief note
ii. Data & the nature of measurement
iii. Conducting an experiment
iv. Methods of Cognitive Science | A very brief overview
v. Survey research
vi. Sampling

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QUANTITATIVE OR QUALITATIVE?

A BRIEF NOTE

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Quantitative research

- Concerned with quantifying phenomena.
  - Measuring and counting.
- Belief that knowledge stems from accurate measurement.
- Tends to employ hypothetico-deductive approach.

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Quantitative research (Continued)

- Tends to:
  - be conducted in controlled settings.
  - emphasise behaviour rather than meaning.
  - be concerned with prediction.
  - use experimental and/or structured methods.

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Qualitative research

- Concerned with the quality or qualities of phenomena.
- This tends to be analysis of text and meaning.
- Rejection of simple belief in relationship between our perception of the world and the world itself.

Qualitative research (Continued)

- Tends to:
  - focus on an inductive rather than hypothetico-deductive approach.
  - focus on understanding meanings (not truths).
  - describe rather than explain.
  - rely on a small number of participants.
  - rely on semi-structured or unstructured interviews.

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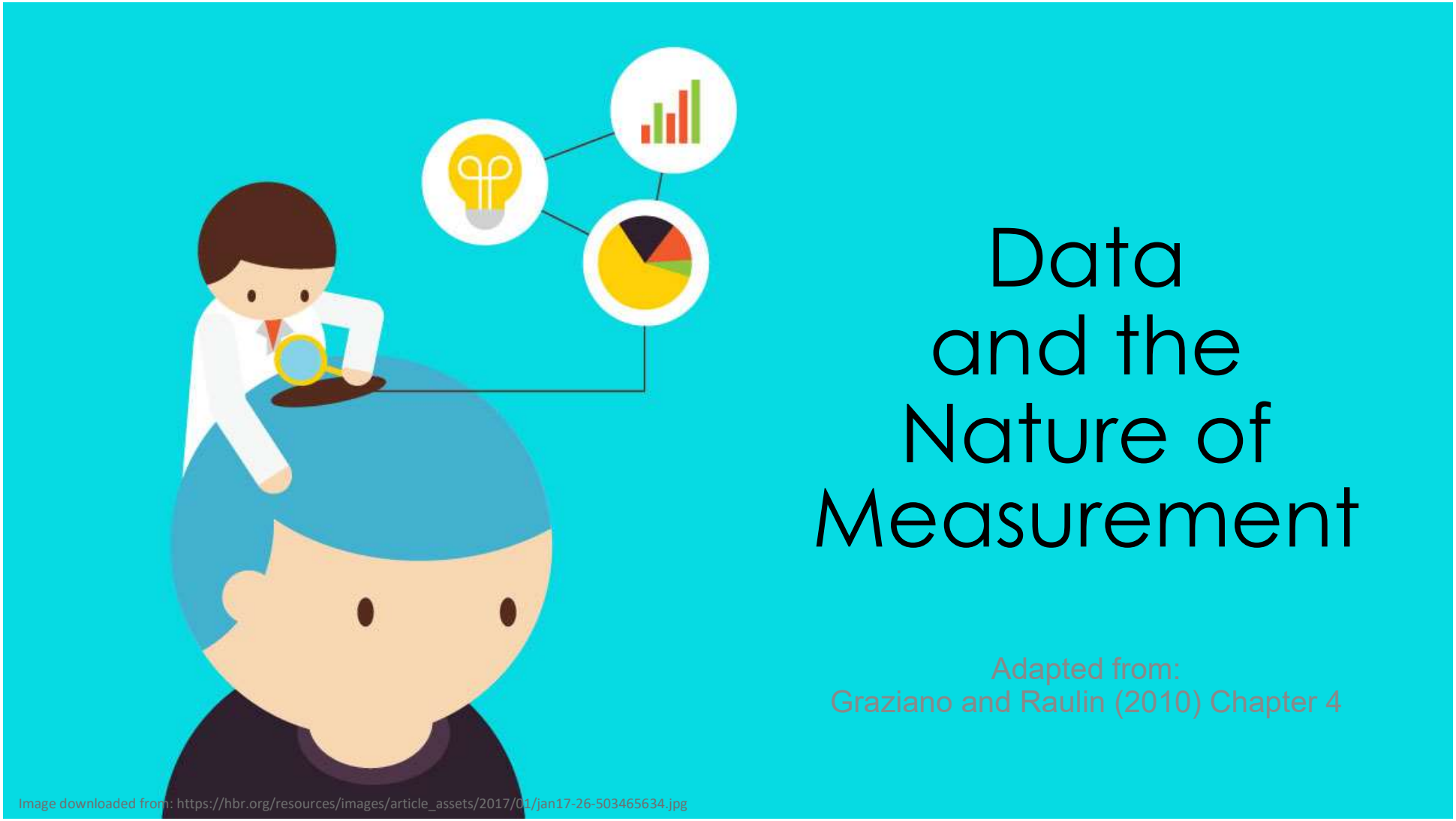
Methods

- Different methods are needed to answer different questions.
- Quantitative research | How many?
- Qualitative research | What? Why?



Data and the Nature of Measurement

Adapted from:
Graziano and Raulin (2010) Chapter 4

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Research Variables

- **Variable**: Any characteristic that can take on more than one value
  - Examples: speed, level of hostility, accuracy of feedback, reaction time
- Research is the study of the relationship among variables
  - Therefore, there must be at least two variables in a research study (or there is no relationship to study)

Measuring Variables

- **Measurement**: Assigning numbers to indicate the level of a variable
  - Sometimes the number assignment is intuitive (e.g., time measured in seconds)
  - Sometimes it is more arbitrary (e.g., 1 for male and 2 for female)

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Scales of Measurement

- Based on how closely the measurement scale matches the real number system
- Scales of Measurement (Stevens, 1946, 1957)
  - Nominal
  - Ordinal

  } Categorical
  - Interval
  - Ratio

  } Numeric

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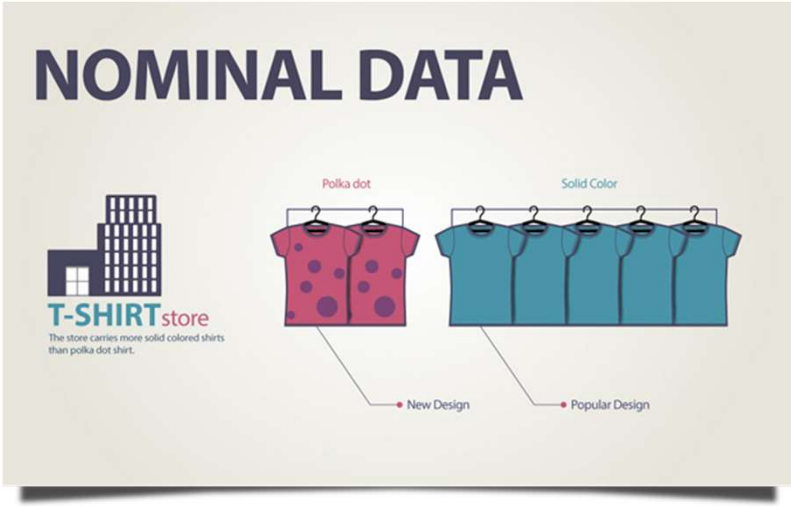
Properties of the Abstract Number System

- **Identity:** Each number has a particular meaning.
- **Magnitude:** Numbers have an inherent order from smaller to larger.
- **Equal intervals:** The difference between units is the same anywhere on the scale.
- **True zero:** Zero indicates there is no amount of the variable.

Nominal Scales

- Naming scale
  - Each number reflects a category
  - *Examples:* diagnostic categories, political affiliations
- Produces nominal or categorical data
- Mathematical properties
  - Identity



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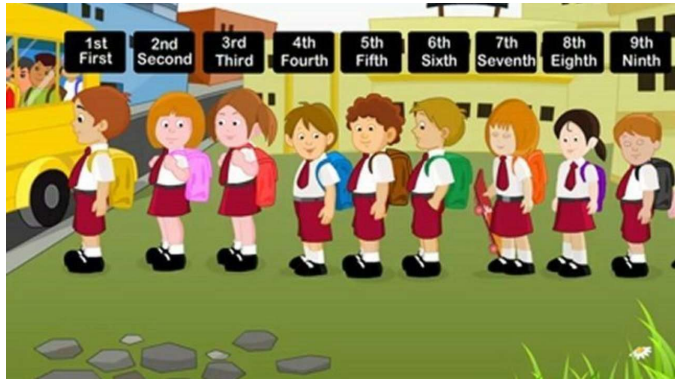
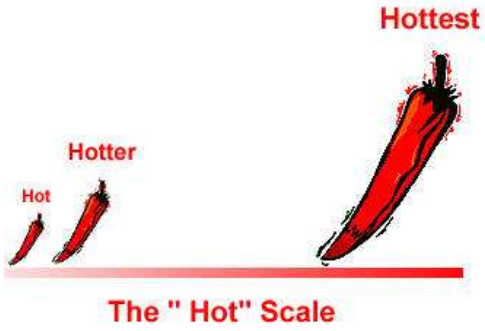
Ordinal Scales

- Scale indicating rank order
  - Reflects the order, but not the amount *Examples:* order of finish in a race, class rankings
- Produces ordered data
- Mathematical properties
  - Identity
  - Magnitude





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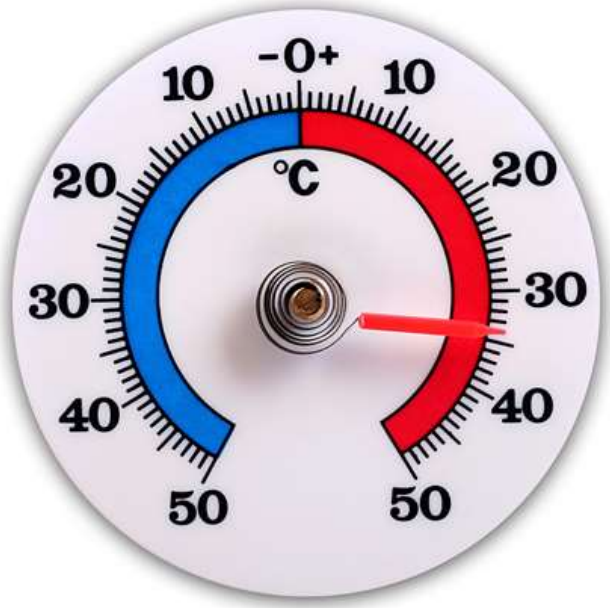
Interval Scales

- Scale with equal intervals
  - The scale indicates amount, but with no zero point
  - *Examples:* temperature on the Celsius scale, most psychological tests
- Produces score data
- Mathematical properties
  - Identity
  - Magnitude
  - Equal intervals



- Zero is arbitrary
- 20C is not twice as hot as 10C
- But difference between 20C and 10C and between 30C and 40C is the same.

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Ratio Scales

- Scale that fits the number system well
  - Includes equal intervals and a true zero
  - *Examples:* time, distance, frequency
- Produces score data
- Mathematical properties
  - Identity
  - Magnitude
  - Equal intervals
  - True zero

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Psychological Tests

- Most psychological & social science tests fall somewhere between an ordinal and a ratio scale
  - Ordinal in that the distance between scores may not be equal
  - Ratio in that one can view the test score as the number of correct items
- Norm is to assume such tests represent an interval scale

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Measurement Error

- Decreases the accuracy of measurement
- Possible sources of measurement error
  - Response set biases
  - Inconsistent measurement procedures
  - Sloppy procedures
  - Unreliable measures

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Reminder from yesterday

Reliability

- The consistency of measurement
- Consistency can be conceptualized in different ways
  - Therefore, there are different types of reliability
- Usually measured with a correlation
  - Sensitive to the consistency of rank orderings of participants

Types of Reliability

- Interrater reliability
  degree of agreement between two independent raters
- Test-retest reliability
  degree of consistency over time
- Internal consistency reliability
  degree to which the items of a measure all measure the same thing

Validity

- A scale is valid if it measures what it is supposed to measure
- Validity also refers to how well a scale predicts other variables
  - *Example:* An IQ test is likely to be a valid predictor of grades in school.

Measuring Validity

- Validity is usually measured with a correlation
  - The correlation is between
    - The measure and
    - A SPECIFIED criterion measure
  - Always list the criterion when reporting the level of validity
    - *For example*, the IQ test is a valid predictor of school grades, but not a valid predictor of athletic ability.

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Objective Measurement

- The hallmark of science
  - Objective measures produce the same result no matter who does the measuring
  - Therefore, scientific principles will apply no matter who tests these principles
- Objective measures reduce biases that could distort results

Conducting an Experiment: General Principles

Adapted from Beins (2009) Chapter 6

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What is an *experiment*?

- The researcher creates equivalent groups through random assignment
- There is at least one systematically manipulated independent variable
- The researcher compares the groups to see if their behavior differs on the dependent variable

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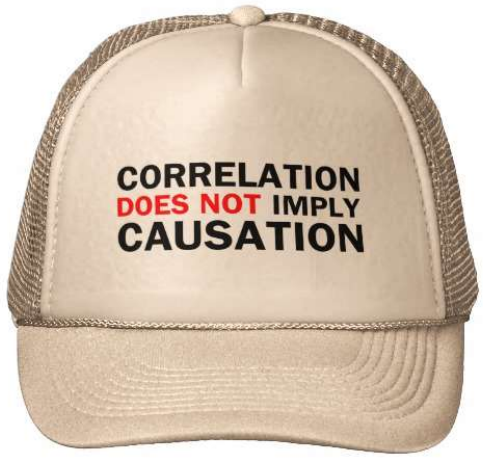
Requirements for determining the Causes of Behaviour

- Covariance rule: The two variables have to vary together in a predictable fashion.
- This characteristic is *correlation*, which is necessary, but not sufficient, to identify causes



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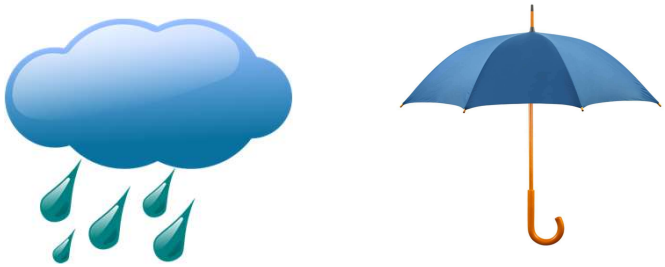
Requirements for determining the Causes of Behaviour | Continued

- Temporal precedence rule: The causal variable has to precede the effect



- Internal validity rule: The causal variable must be the most plausible cause, and other causal variables must be ruled out

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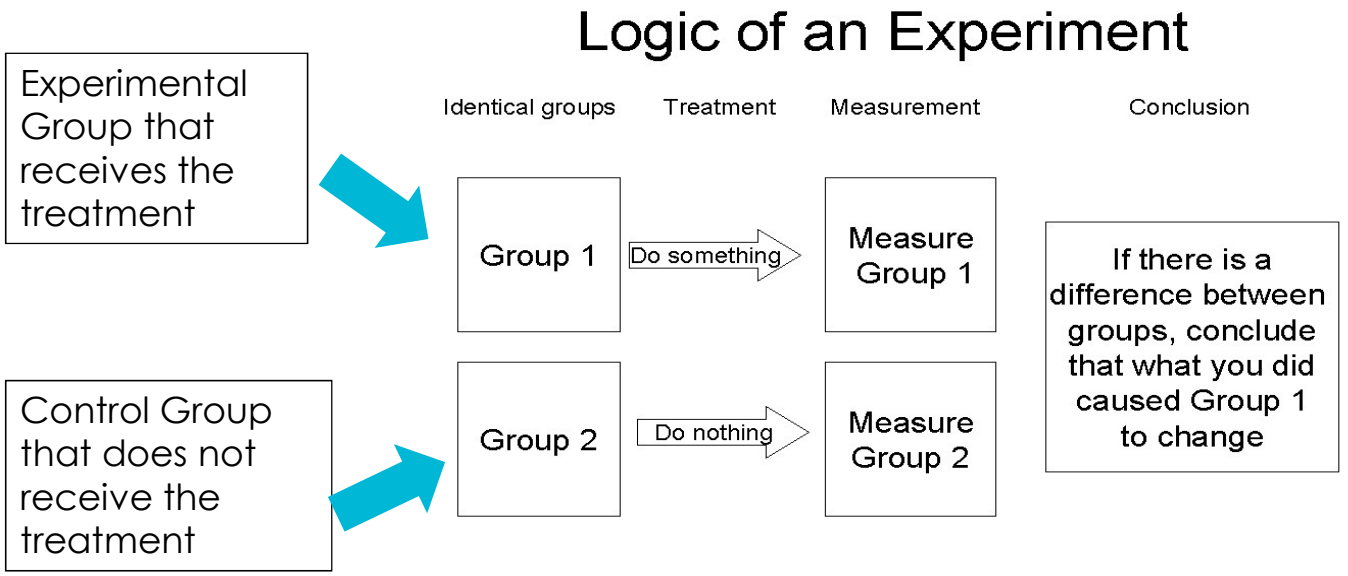
The Logic of Experimental Manipulation

The simplest experimental design



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The Logic of Experimental Manipulation

- Experimental Group The group or groups that receive a treatment.
  - The simplest experiment has one experimental group, but some experiments have more than one.
- Control Group The group that receives no treatment
  - The experimental group is compared with the control group
- Placebo Group A group similar to a Control Group but that receives a fake treatment.

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Lack of Control in Experimental Research

- Extraneous Variable A variable that the investigator is not studying that may affect the behaviours being studied

- Confound A variable not controlled by the experimenter that has a systematic effect on at least one group in the experiment

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Example of an Extraneous Variable

- Researchers found that children who had night lights as infants became nearsighted (myopic) afterward.
- When children did not have night lights, they were less likely to show nearsightedness.
- Could the presence of night lights have caused the myopia?

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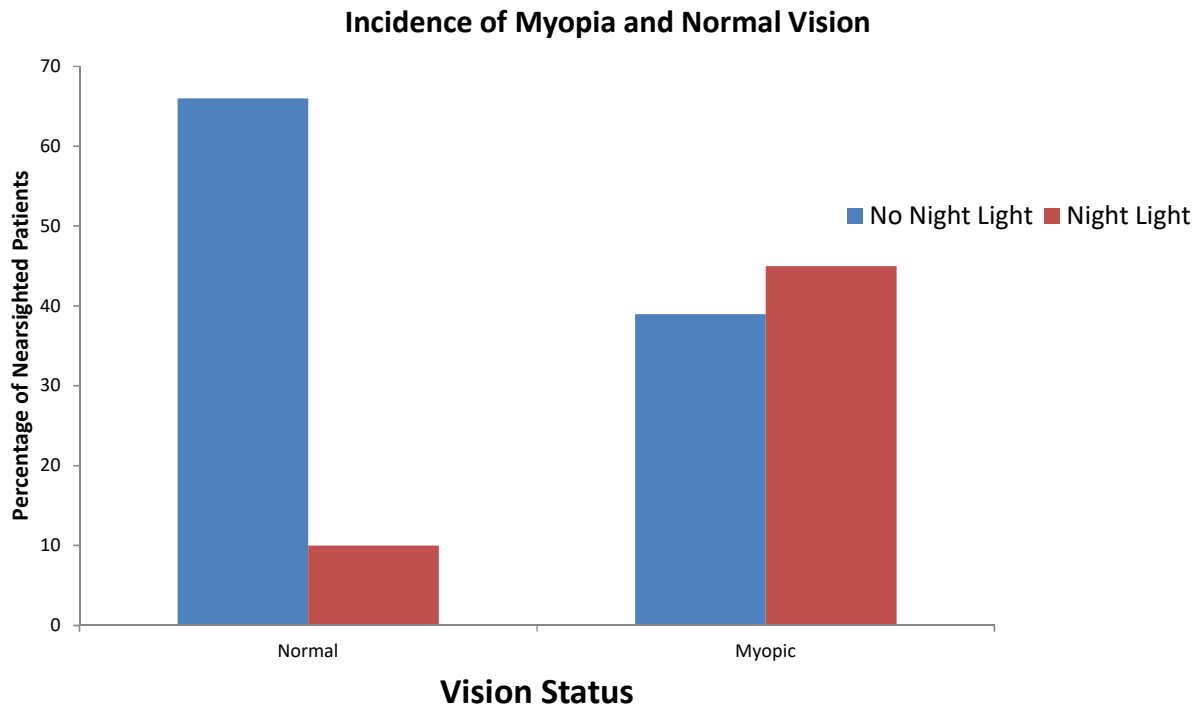
Example of an Extraneous Variable



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Example of an Extraneous Variable

- Are there other variables that might be related to nearsightedness?
  - Nearsightedness is partially hereditary.
  - Nearsighted parents may need night lights.
  - Their children may become nearsighted not because of night lights, but because of the genetic inheritance from parents.
- Subsequent research showed that night lights are not causally related to nearsightedness; the relation is only correlational.

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Experimenter Effects

- Experimenter Bias The tendency of researchers to inadvertently affect participants' behaviours, obscuring the effect of the independent variable

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Participant Effects

- Participants try to figure out what the study is about and may try to "help out" the experimenter by acting "the right way", which is not good for the study.

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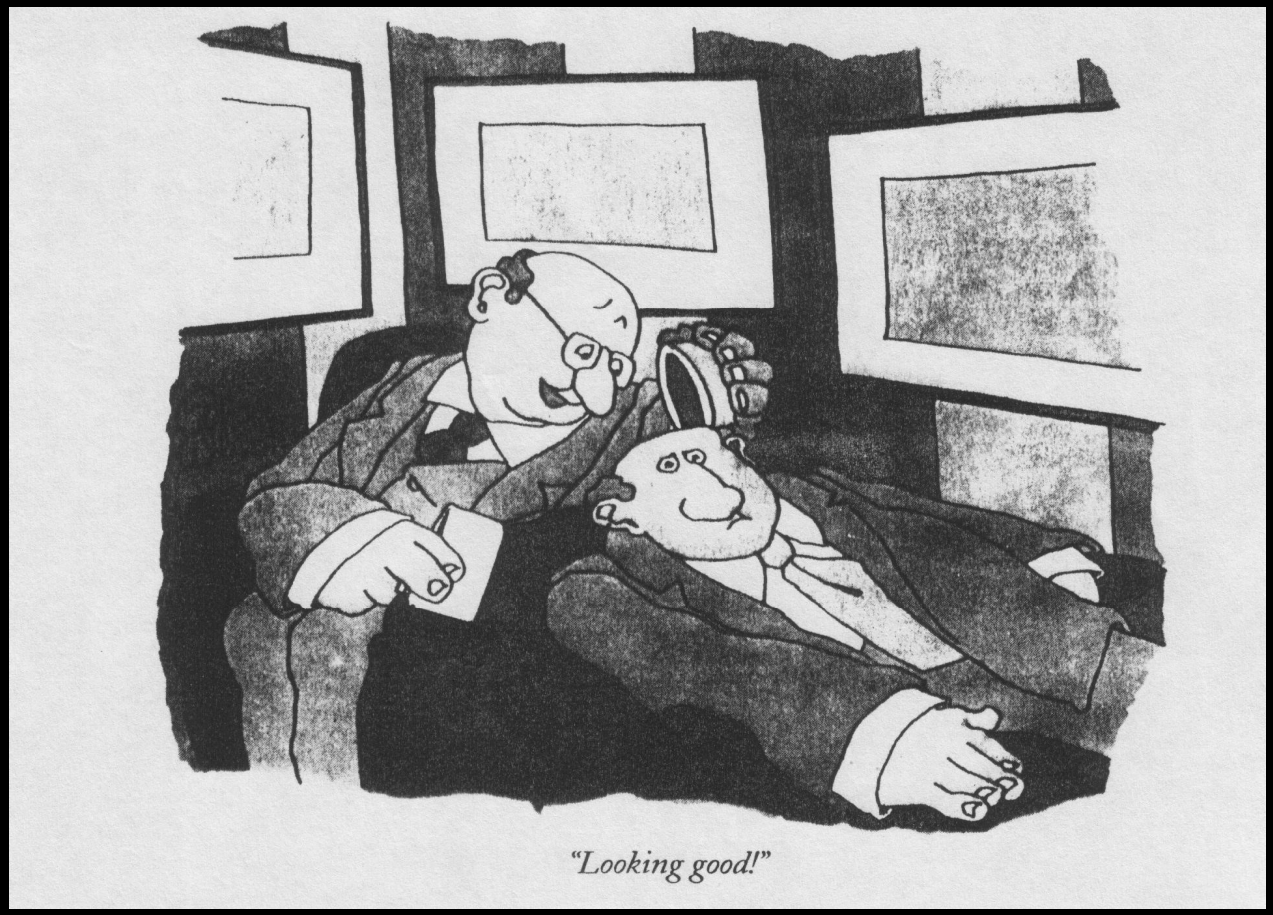
Countering Participant Effects

- Cover story The researcher can create a story that disguises the purpose of the study.
- Blind study
  - Single blind study The participants do not know what condition they are in.
  - Double blind study Neither experimenters nor participants know what group the participants are in.

Other Participant Effects

- Hawthorne Effect The tendency by participants to act differently than normal because they know they are being studied.
- Demand Characteristics The tendency by participants to respond to what they think the experimenter wants (or demands) from them
- Evaluation Apprehension The tendency to feel inadequate or to experience unease when being observed.



Methods of Cognitive Science

A brief introduction

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Cognition

- Cognition – from Latin base cognitio – "know together"
- The collection of mental processes and activities used in perceiving, learning, remembering, thinking, and understanding
- and the act of using those processes

Cognitive Processes

- Learning and Memory
- Thinking and Reasoning (Planning, Decision Making, Problem Solving ...)
- Language
- Vision-Perception
- Social Cognition
- Dreaming and Consciousness

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So what *IS* Cognitive Science?

Some possible definitions:

- *The (interdisciplinary) study of mind and intelligence.*
- *The study of cognitive processes involved in the acquisition, representation and use of human knowledge.*
- *The scientific study of the mind, the brain, and intelligent behaviour, whether in humans, animals, machines or the abstract.*

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Experimental Studies

- Focus on understanding how objects or ideas are represented in the brain and how these representations are manipulated.
- Fundamental goals include identifying the mental operations that are required to perform cognitive tasks and exploring the limitations in task performance.

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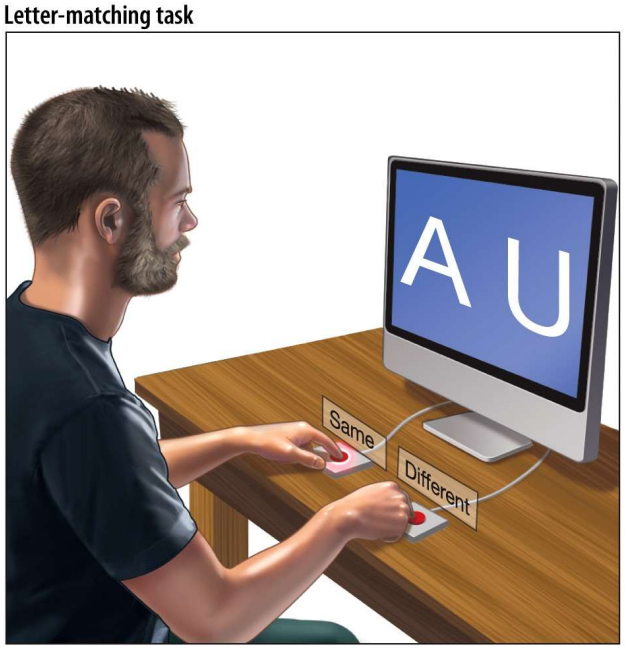
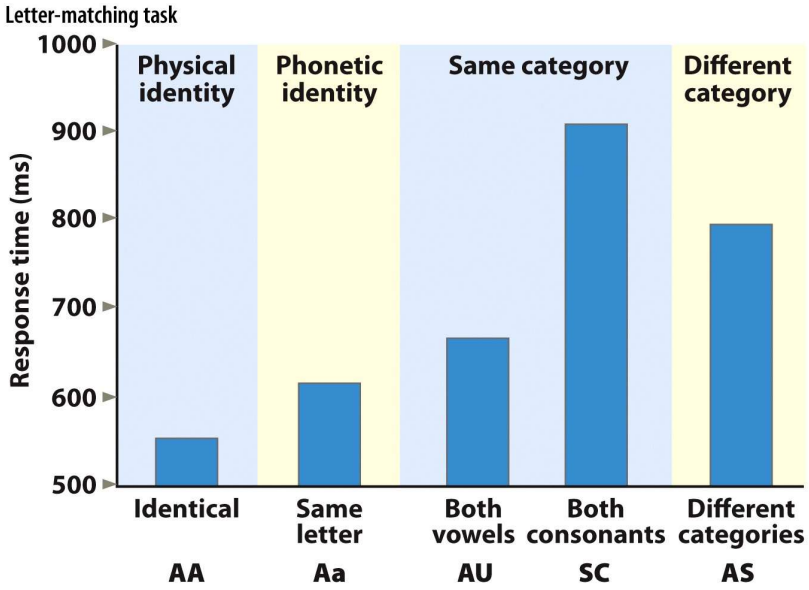
Experimental Studies | Example

Common Cognitive Tasks: Letter Matching

- What processes underlie decision making?
- Using Reaction Time





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Experimental Studies | Example

Common Cognitive Task: Stroop

Task:

Name the colour of the "ink" as fast as possible

Stroop task

Color matches word	Color without word	Color doesn't match word
RED	XXXXX	GREEN
GREEN	XXXXX	BLUE
RED	XXXXX	RED
BLUE	XXXXX	BLUE
BLUE	XXXXX	GREEN
GREEN	XXXXX	RED
BLUE	XXXXX	GREEN
RED	XXXXX	BLUE

Change detection needs Attention

- People do not store many details of a scene in memory. In order to see an object change it is necessary to attend to the object.
- The blank image swamps the local-motion signal that would ordinarily be caused by a change in an object, so attention is not drawn to the change.
- The presence of the mask (grey screen) prevents automatic detection of change.

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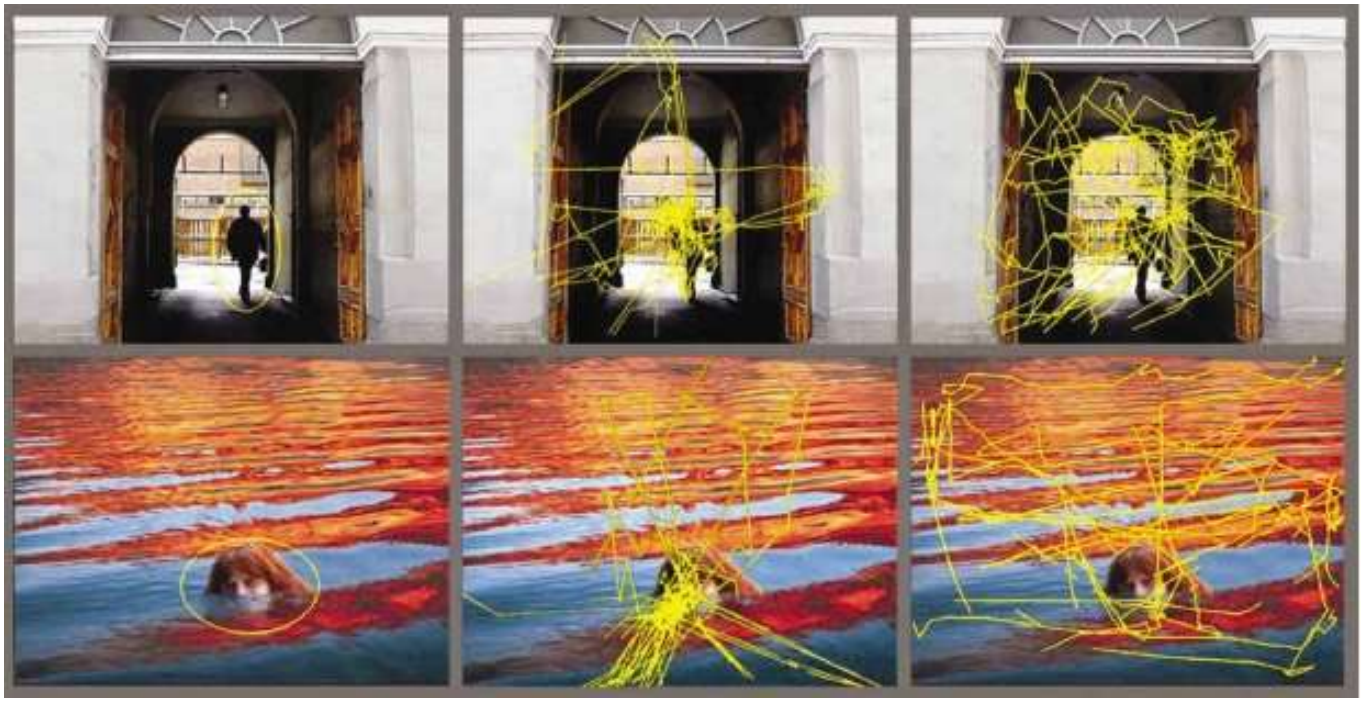
Example of eye-tracking study

Eye-movement patterns | artists & laypeople

Vogt & Magnussen (2007)

Untrained participant Artist



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Basis for Electroencephalography (EEG)

- Cognitive activity is associated with increased activity of neurons in the brain
- Neurons performing similar functions tend to cluster together (functional specialization)
- Neural activity generates electrical signals – which can be measured by EEG

Survey Research

Adapted from:
Graziano and Raulin (2010) Chapter 13

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Survey Research

- A widely used research technique
  - Provides information about people's attitudes, experience, and knowledge
  - Used extensively by researchers and others (politicians, news organizations, etc.)

Types of Surveys

- Status surveys
  - Descriptive survey about the current status of the population sampled
  - Descriptive information can guide policy and inform policy makers
- Survey research
  - Seeks to identify relationships among the variables studied in the survey

Steps in Survey Research

1. Determine what area of information is to be sought.
2. Define the population to be studied.
3. Decide how the survey is to be administered.
4. Construct the first draft of the survey instrument; edit and refine the draft.

Steps in Survey Research

5. Pretest the survey with a subsample; refine it further.
6. Develop a sampling frame and draw a representative sample.
7. Administer the final form of the instrument to the sample.
8. Analyze, interpret, and communicate the results.

Developing a Survey Instrument

- Use clear and explicit instructions
- Types and number of questions will depend on the purpose and the type of survey planned
- Types of items
  - Open-ended items
  - Multiple-choice (pre-coded) items
  - Likert-scale items

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Sample Open-Ended Questions

- How do you handle interpersonal difficulties with your co-workers?
- What are the most important values to instill into today's children?
- If you were president, what issues would be your highest priority?
- What situations are particularly stressful for you?

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Sample Multiple-Choice (pre-coded) Questions

How frequently do you take a sick day from work?

a) never
b) once or twice a year
c) 3 to 5 times a year
d) 6 to 12 times a year
e) at least once a month

Identify the issue that you believe is most critical to this country's future.

a) the economy
b) education
c) integrity in government
d) national defense
e) some other issue

Sample Likert-Scale Questions

Rate each item on the scale shown to indicate your level of agreement:

- I believe that the General Data Protection Regulation is good for citizens in the EU.

  strongly agree agree uncertain disagree strongly disagree

- I think that everyone should vote.

  strongly agree agree uncertain disagree strongly disagree

- Most politicians cannot be trusted.

  strongly agree agree uncertain disagree strongly disagree

Sampling

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Some Terminology

- Population: The complete group of interest (e.g., students at university, cars, EU regulations)
- Census: Investigation of all individual elements that make up a population
- Sample: "a smaller (but hopefully representative) collection of units from a population used to determine truths about that population" (Field, 2005)

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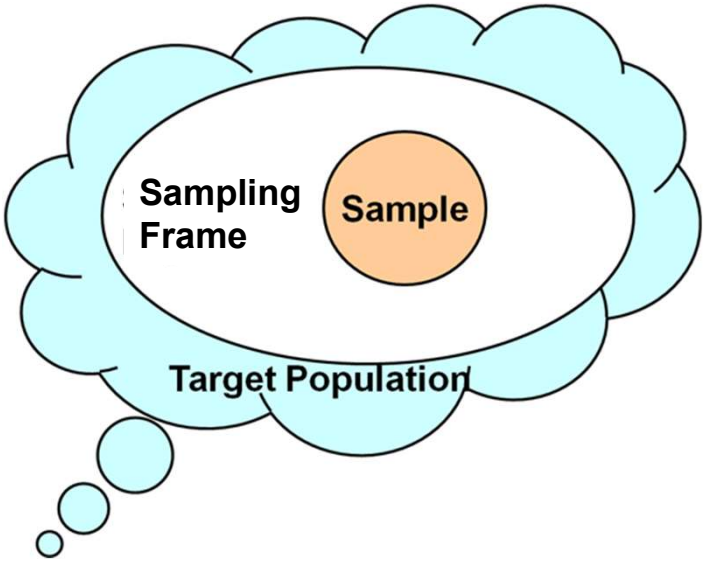
Some Terminology

- Sampling frame The list from which the potential respondents are drawn
- Examples:
  - Electoral registrar, Registrar's student database, telephone directory
- Need to assess sampling frame errors



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Why use samples?

- Resources (time, money)
- Speed
- Gives results with known accuracy that can be calculated mathematically

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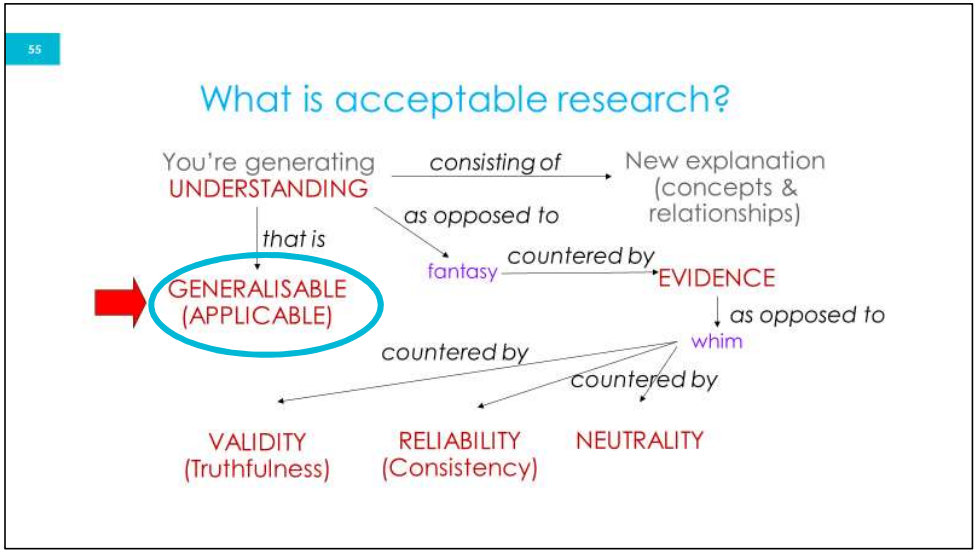
Why is sampling important?

- The more representative the sample, the more valid the conclusions from the survey



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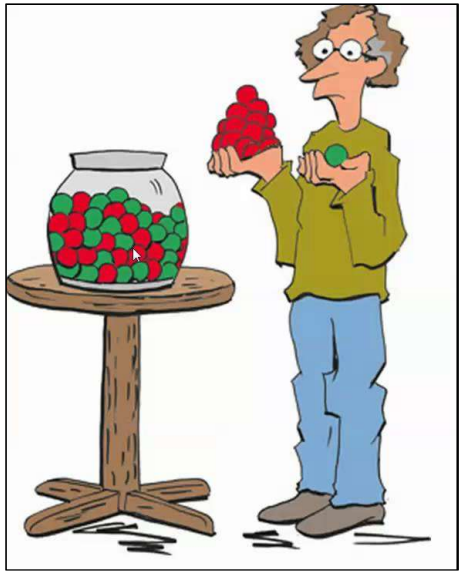
What can influence a sample's representativeness?

- Sampling procedure
- Sample size
- Participation (response)



Two Major Categories of Sampling

- Probability sampling
  - Known, nonzero probability for every element
- Nonprobability sampling
  - Probability of selecting any particular member is unknown

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Probability samples

- Simple random sampling
  - Every person has an equal chance of being included
- Systematic Sampling Every nth name from the list will be drawn
- Stratified random sampling
  - Random sampling within clearly defined strata (subdivisions of the population)

NOTE
"*random*" has a very precise meaning in this context, different from colloquial use

Nonprobability samples

- Convenience
- Judgment (aka Purposive)
- Quota
- Snowball

Sample Size

- Sample size is based on several factors
  - Costs and time constraints
  - Degree of precision needed
    - Larger samples provide more precise estimates of population parameters
    - More heterogeneous populations require larger samples

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What is the Appropriate Sample Design?

- Degree of accuracy required
- Resources
- Time
- Advanced knowledge of the population
- Need for statistical analysis

Internet Sampling is Unique

- Internet surveys allow researchers to rapidly reach a large sample.
- Speed is both an advantage and a disadvantage.
- Sample size requirements can be met overnight or almost instantaneously.
- Survey should be kept open long enough so participants selected in sample can take part.

Internet Sampling

- Major disadvantage
  - lack of computer ownership and Internet access/use among certain segments of the population
- Yet Internet samples may be representative of a target populations.
  - target population - visitors to a particular Web site.
- Hard to reach subjects may participate

Web Site Visitors

- Unrestricted samples are clearly convenience samples
- Randomly selecting visitors
- Questionnaire request randomly "pops up"
- Over- representing the more frequent visitors

Panel Samples

- Typically yield a high response rate
  - Members may be compensated for their time with participation in a lottery or a small, cash incentive.
- Database on members
  - Demographic and other information from previous questionnaires
- Select quota samples based on product ownership, lifestyle, or other characteristics.
- Probability Samples from Large Panels

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Internet Samples

- Recruited Ad Hoc Samples
- Opt-in Lists