# Experimental vs. Observational Designs

Overview

- Objective
  - By the end of this session, you should know which type of design fits which type of research question

- To do that, we will
  - Define validity and reliability
  - Explore principles of experimental design
  - Explore principles of observational design
  - Discuss the suitability of different approaches
  - Have a go at designing an experiment

Before we start

- What would you be interested in applying research methods to?
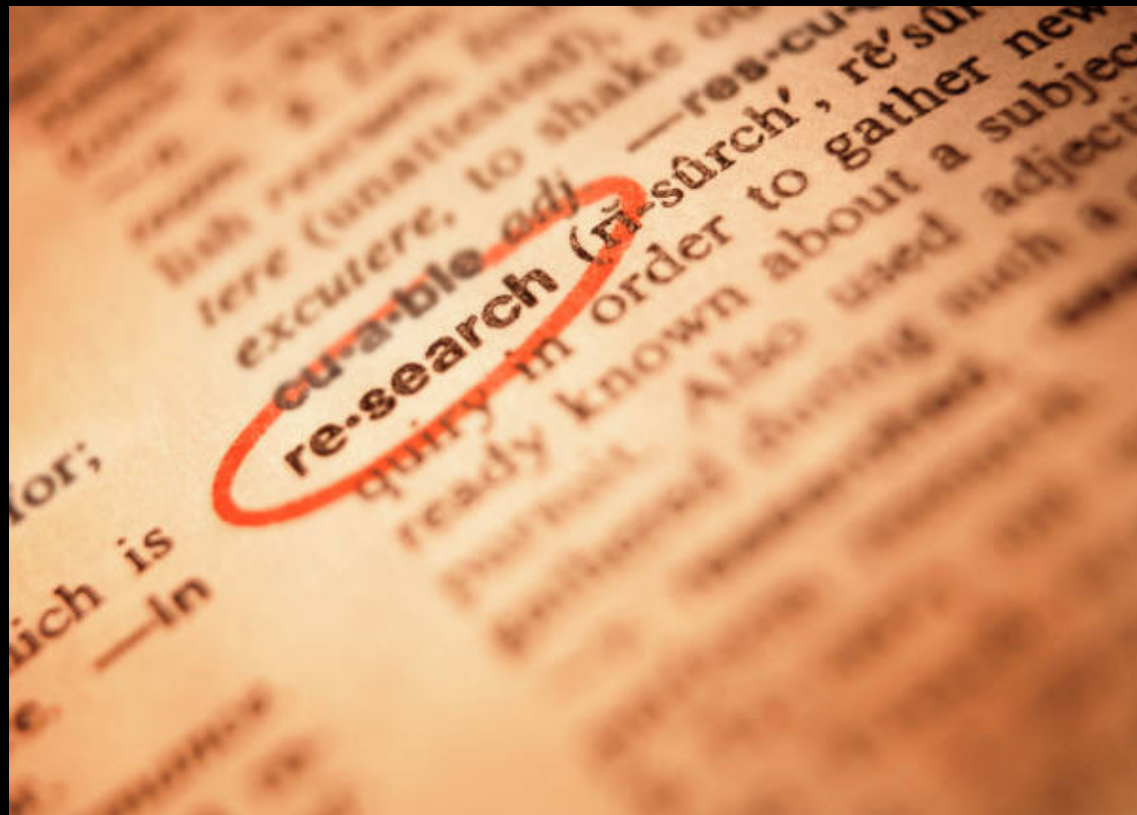
Reliability and validity

- Reliability
  - Does the same object weigh the same amount when measured again?

- Validity
  - Is this an appropriate means of measuring someone's mathematical skills?
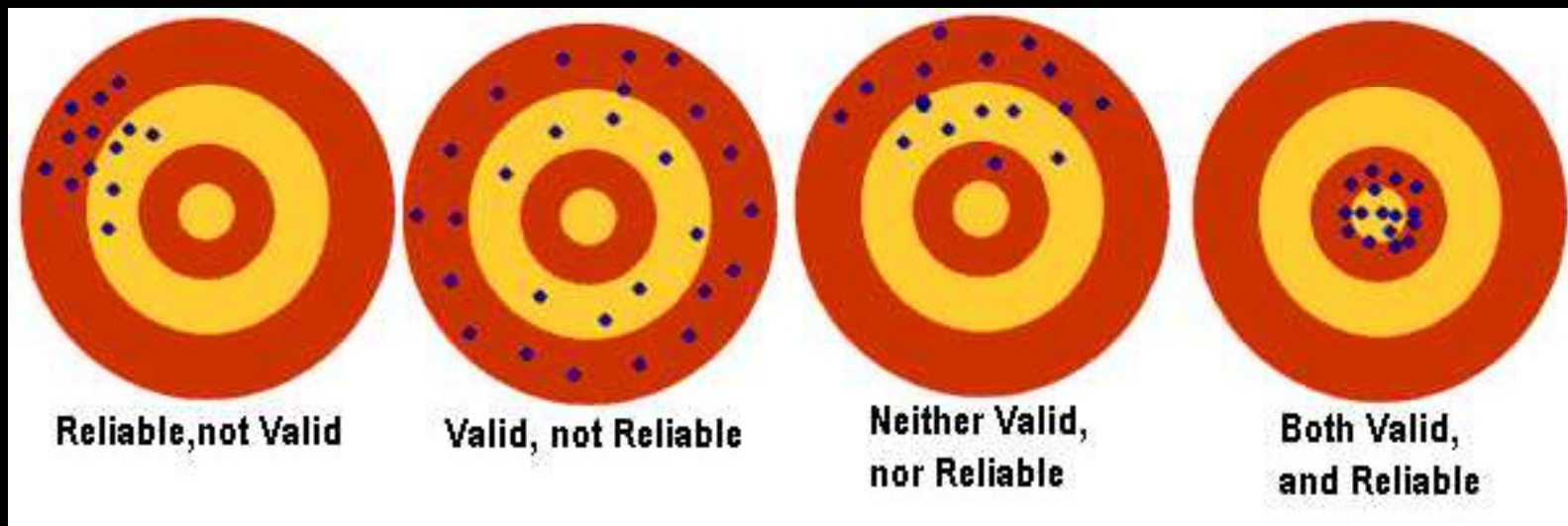
Reliability

- How stable is the score?
  - Observed score = true score + error

- What affects reliability?
  - Human error (misreading score)
  - Test reliability (faulty scales)

- How can we improve reliability?
  - Objective tests
  - Careful test construction

Validity

- Are we measuring what we think we're measuring?

- What affects validity?
  - The relevance of the measure we use (e.g. weight vs. maths test)

- How can we improve validity?
  - By matching the measure to the question (reaction times? interviews?)
  - By always asking ourselves what might be contaminating our results (bad design? something else affecting outcome?)

Reliability and validity

- Can be affected by resources (time, money), but should always be the first priority in research

Reliable, not Valid   Valid, not Reliable   Neither Valid, nor Reliable   Both Valid, and Reliable

Experimental designs

Experimental designs

- General idea
    - Manipulate something (the Independent Variable, IV), and look at the effect of that manipulation of something else (the Dependent Variable, DV)

- Types of design
    - Between-groups design (e.g. musicians compared to non-musicians)
    - Within-groups design (e.g. pre-intervention vs. post-intervention using the same group of people)
    - Mixed design (e.g. musicians and non-musicians pre- and post-intervention)

Experimental designs

- Control
  - Observed score = true score + error
  - Maximise explained variance (true score)
  - Minimise unexplained variance (error)

- Generalisability
  - Big enough sample?
  - Enough measurements within each person?
  - Statistical significance (more on this next week)

Experimental designs

- Examples
  - Manipulate the distance between a chord and the key of the piece it's in (IV) → see how high participants' oddity ratings are (DV)

  - Give participants a musical extract to listen to with or without (IV) a title → see how moving they find the piece

  - Give a group of nervous musicians a beta-blocker or a placebo (IV) → see how that affects their performance accuracy (DV)…

Experimental designs

- Limitations
  - Some things you just can't manipulate!
    - Practically (a historical event that brings a change to the style of music compositions)
    - Ethically (studying the long term effects of taking harmful drugs)

  - Ecological validity
    - Are the outcomes generalisable beyond the "lab"?

  - Can't control everything but...
    - That's where statistics come in handy
    - Can make good inferences from data

Experimental designs

- A research question for which an experimental design would be appropriate

Observational designs

Observational designs

- General idea
  - See what happens in the world (while manipulating as little as possible)

- Types of observational designs
  - Behaviour observations
  - Linguistic observations
  - Longitudinal studies
  - "Diary" studies...

Observational designs

- "Naturalistic" approach
  - Experimenter does not influence the situation
  - Less control, but more "real"?

- Clear rationale
  - Clear coding to reduce observer bias
  - Clear selection criteria to reduce selection bias

- Aim: maximising validity and reliability

Observational designs

- Examples
  - The academic achievements of children in different postcode areas
  - The rise of "new music" composition in line with political instability in the cold war
  - The increasing cross-influence of musical genres with faster internet globalisation
  - The personality characteristics of different orchestral instrument players
  - Habits of musical listening in musicians and non-musicians…

Observational designs

- Limitations
  - Causality difficult to prove
    - Price of bananas correlates negatively with male life expectancy
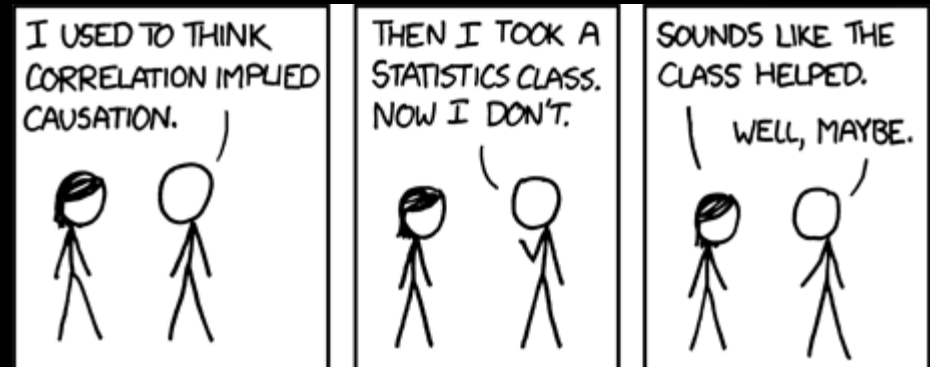
  - Access to populations can be difficult and ethically complex
    - Children, clinical, forensic, online (anonymity, confidentiality), drop-out rate...

  - Bias and confounds difficult to control
    - Inter-observer reliability, interpretation bias
    - Can observation cause behaviour?

Observational designs

- A research question for which an observational design would be appropriate

A compromise?

- Quasi-experimental designs
  - When it's not possible to randomly assign people to groups (e.g. children whose parents have given them music lessons vs. children whose parents haven't)

  - "Non-equivalent groups design" – there is likely to be a baseline difference (prior to any intervention)

  - Can be corrected with some statistics. Important to be aware of potential confounds (socio-economic status, parental interest in music, family encouragement...)

A quasi-experimental approach

- Patients with Parkinson's Disease – effect of Ballet lessons
  - http://www.bbc.co.uk/news/uk-england-london-16573752

  - Not all affected by PD to the same extent at the start of the intervention
  - Experimental manipulation: ballet lessons (control: no ballet lessons?)
  - Outcome: measure difference between baseline movement abilities and movement abilities at end of study – interviews, videos, balance measurements...
  - http://www.ballet.org.uk/editorial.php?ref=DanceForParkinsons

Group work

- Think of a research question
- What kind of design would be best suited?
- How would you ensure reliability and validity?

Any questions?

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- Next week: Introduction to quantitative analysis