ESSENTIAL

Evolving Security ScienE through Networked Technologies, Information policy And Law

Psychological Science Research Methods #1

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Session Plan

i. The Scientific Method
ii. What is acceptable research?
iii. Quantitative or qualitative? A brief note

Acknowledgements:
Some of the material in this presentation has been adapted from the Research Methodology course at the University of Sheffield
Also contains material from:
Beins (2009). Robinson-Riegler & Robinson-Riegler (2008); Ray 4e (1993); Graziano & Raulin 2e (1993)

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How do we acquire knowledge?

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Different ways of acquiring knowledge

- Tenacity *It has always been that way.*
- Intuition *It feels true.*
- Authority *The boss/king/religious leader/ says it is true.*
- Rationalism *It makes sense logically.*
- Empiricism *I observed it to be true.*
- Science *A combination of rationalism and empiricism.*

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A new way to explain explanation

David Deutsch TED talk:

Available at:
https://www.ted.com/talks/david_deutsch_a_new_way_to_explain_explanation

- *Testability*
- *Good explanation (hard to vary)*

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What is Science?

Science is
a way of knowing

Science is
a process of inquiry, a particular way of thinking

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Science and Art

- Often thought of as polar opposites
  - Science as precise and constrained
  - Art as free flowing and creative
  - This dichotomy is false
- Scientists and artists share a creative drive to understand and represent reality
- Creative people are often gifted in both science and art (e.g., Leonardo da Vinci)

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Characteristics of Scientific Knowledge

- **Objective**

  Clearly specified and well defined
- **Data Driven**

  Conclusions are based on the data
- **Public**

  The research is made public, in detail, so others can scrutinize it
- **Replicable and Verifiable**

  Other investigators can repeat the research to see if the same results occur

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Characteristics of Bogus (false) Science

- Claims appear in the popular press rather than in scientific journals
- People claim that the scientific establishment is trying to suppress their work.
- Independent researchers cannot verify claims
- Claims are based on anecdotes rather than on systematic data collection.

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Characteristics of Bogus (false) Science
continued

- Proponents simply assert that the truth has been known for a long time (e.g., centuries) when no current research can document the claims.
- Junk Science: When scientists or researchers make claims to support their own interests, going beyond what the data support

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The role of the government in science

- A lot of research is funded by governments either directly or through funding bodies.
- Some research is applied, with possible applications.
- Some research is theoretical, possibly without future applications.

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The Interaction of Science and Culture

- Researchers are part of the culture and often study issues that are important in life.
- Culture helps determine how scientists conduct their research.

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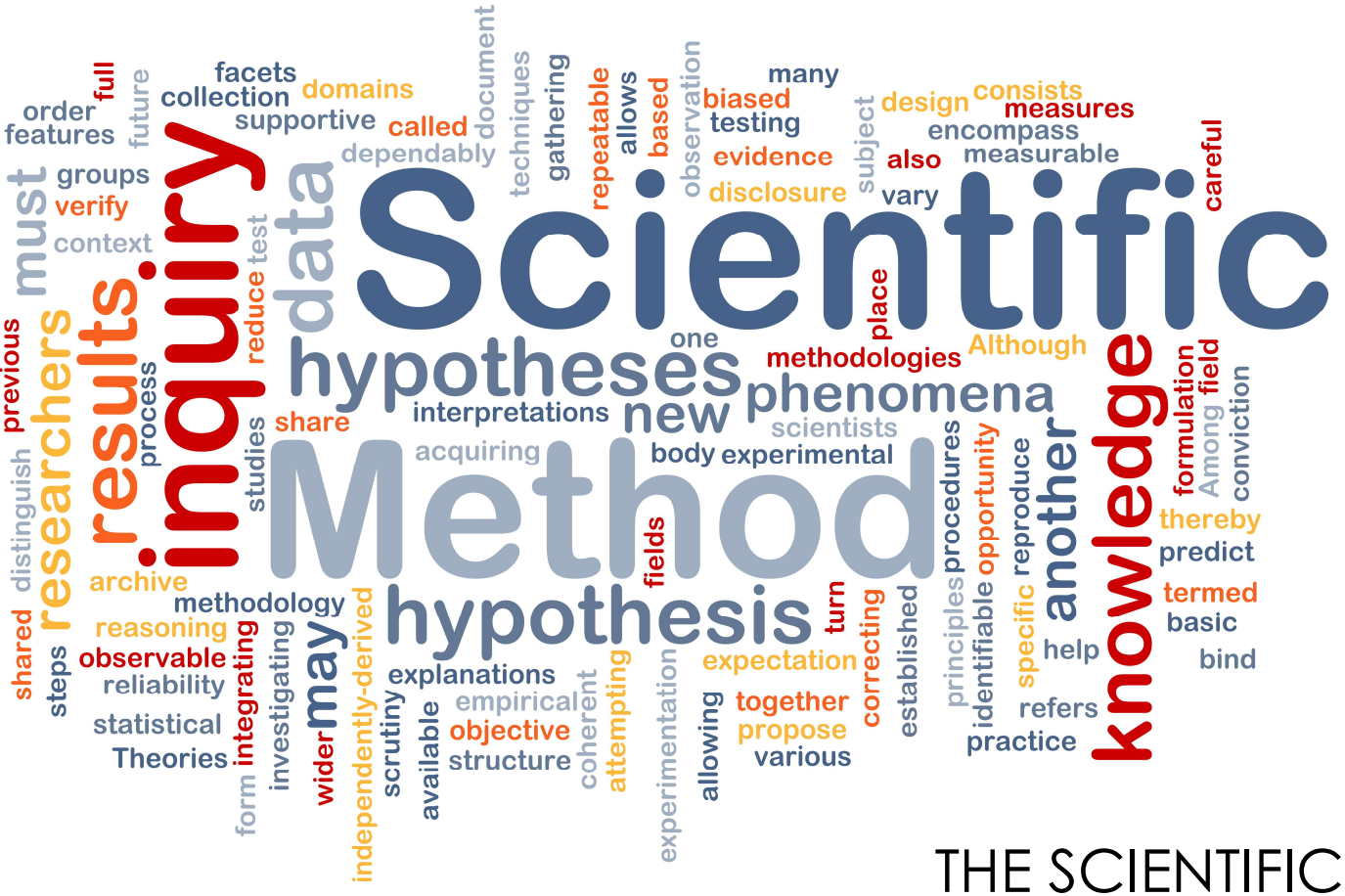
Scientific publishing

- Peer review
- Post publication peer evaluation, scrutiny, response
- Current controversies:
  - Open Access



THE SCIENTIFIC METHOD

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The goals of Science

- To **describe**
- To **explain**
- To **predict**
- To determine the **causes**
  - It is only by understanding the causes that one can control or change

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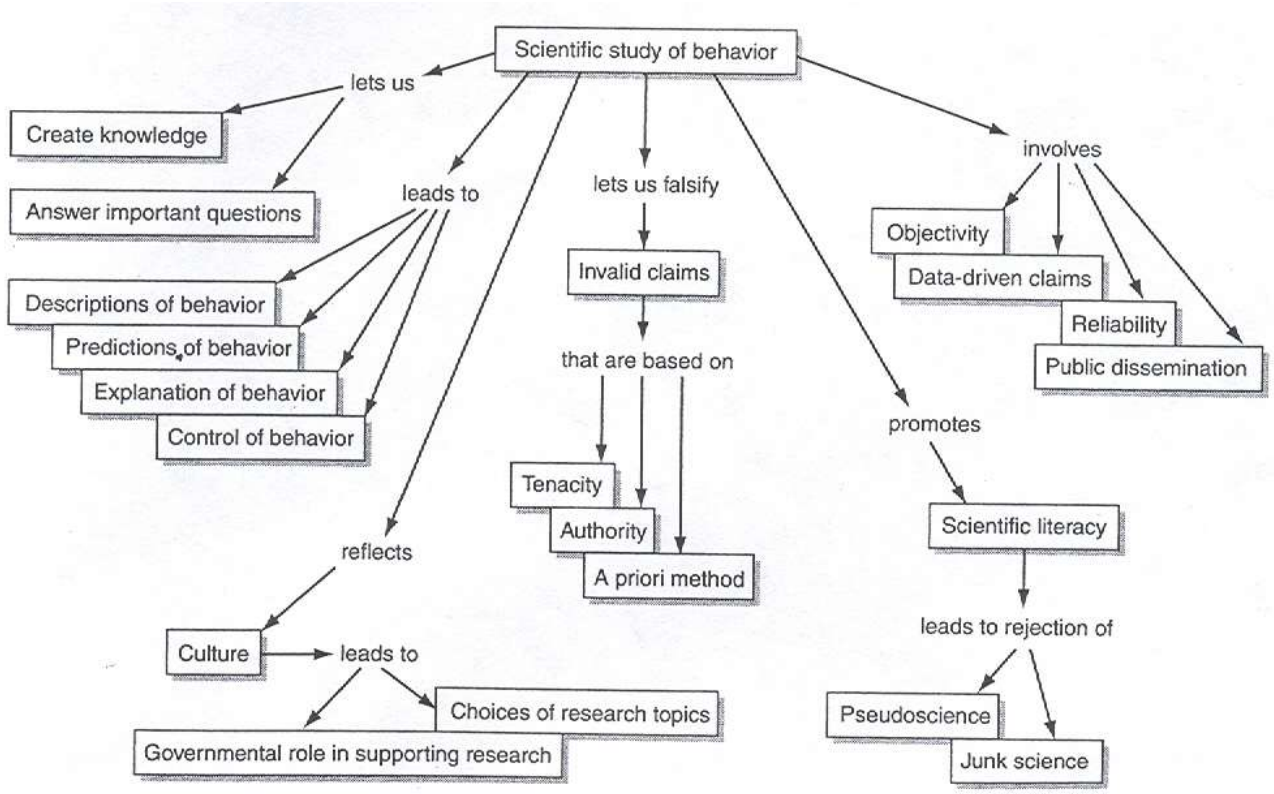
Scientific Study of Behaviour



From Beins (2009)

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Assumptions of Science

- Assumptions are accepted without proof
- Assumptions of science
  - A true, physical universe exists
  - The universe is essentially orderly
  - The principles that define the functioning of the universe can be discovered
  - All ideas are tentative, potentially changed by new information
- These assumptions underlie scientific thinking

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Observation and Inference

- Facts: Events that can be observed
  - Most "facts" of psychological science are behaviours
- Constructs: Inferred from observations
  - Constructed to explain the observations
  - Examples: emotion; personality
  - Used "as if" they really existed
  - Reification of a construct: incorrectly believing it is a fact

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Inductive & Deductive Thinking

- Inductive thinking:
  - from the specific instance to the general theory
- Deductive thinking:
  - from the general theory to make predictions
- Science
  - Develops theories through inductive logic
  - Tests theories by generating predictions through deductive logic and empirically verifying those predictions

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Deductive logic – example

If anxiety is increased, then heart rate will be increased.

Heart rate is increased.

Therefore, anxiety is increased.

INVALID
Affirming the consequent

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INVALID
Affirming the consequent

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If I were a cat, I would have four legs

I do not have four legs

Therefore, I am not a cat

VALID

disconfirmatory reasoning

- "If a card has a vowel on one side, then it must have an even number on the other side."
- Which cards must be turned over to test this rule?

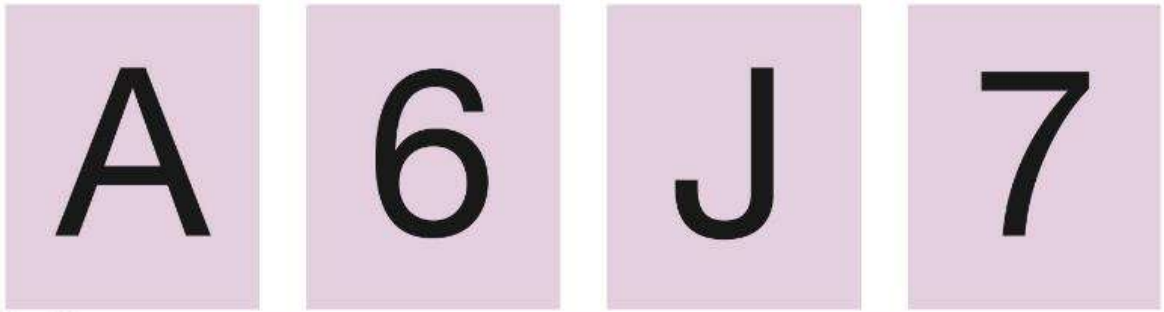

Figure 12.9

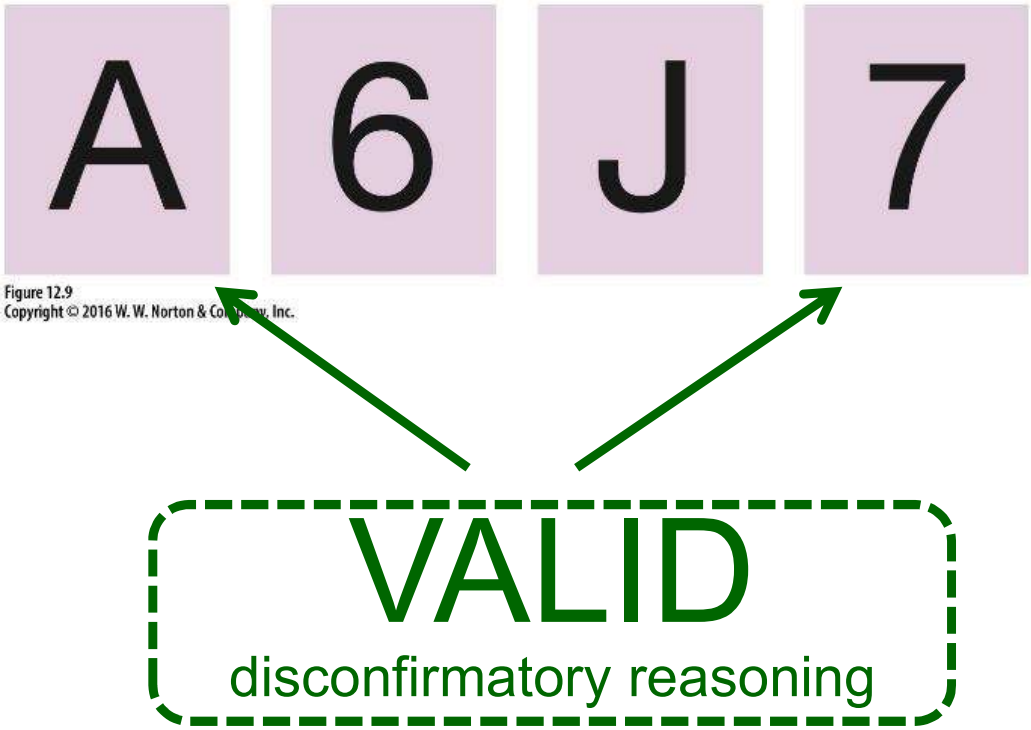

Figure 12.9

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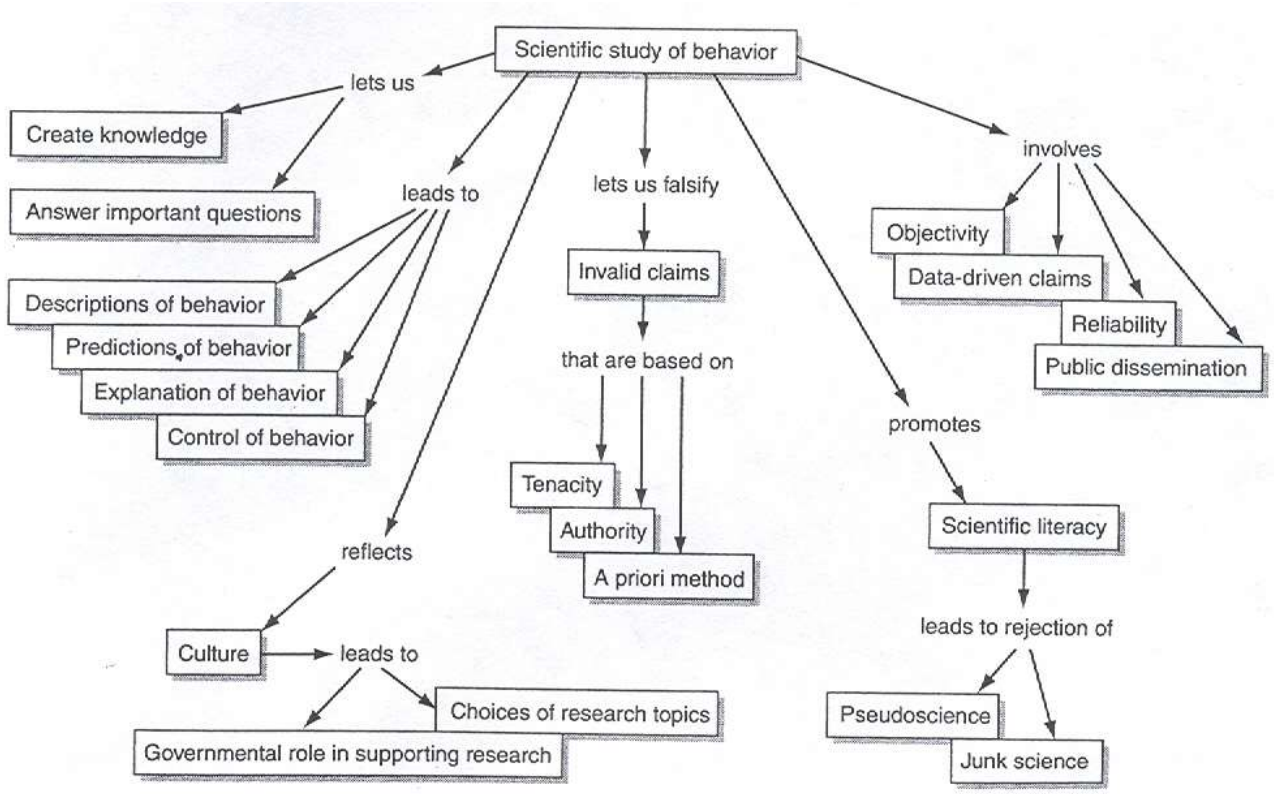
Scientific Study of Behaviour



From Beins (2009)

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Inductive Reasoning - example

- Noellie gets upset when asked if she'll give an extension for an assignment deadline.
- Jeanne won't accept assignments submitted after the deadline.
- Joe takes 20% off the mark for each day an assignment is late.

- From which you might conclude (induce) that:

  - All professors find late submission of assignments unacceptable.

  - Professors with names finishing in a vowel find late submission of assignments unacceptable.

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Inductive Reasoning

- In deductive reasoning conclusions can be labelled valid or invalid with absolute certainty.

- Inductive reasoning leads to *uncertain conclusions that vary in their strength*

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Inductive Reasoning - example

- Robins are susceptible to disease A

…all birds are susceptible to disease A

- Turkeys are susceptible to disease B

…all birds are susceptible to disease B

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Inductive Reasoning

- Inductive arguments are judged on **strength of evidence** rather than validity
- Inductive reasoning must involve constraints of some type
- Inductive reasoning is an important basis for:
  - Categorization - deriving a general principle (i.e., a category) from specific examples
  - Problem Solving - Specific problem situations are used to generate a general problem-solution procedure

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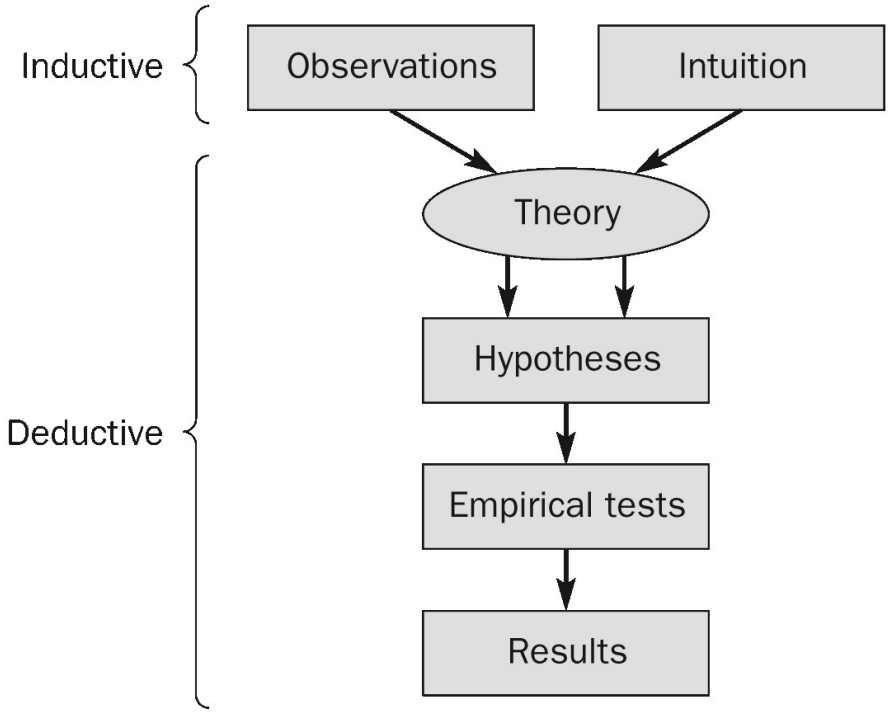
The hypothetico-deductive method



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Theories in Science

- Simplified framework for explaining complex phenomena
- A scientific theory must be both
  - Testable
  - Falsifiable

    And, according to David Deutsch, the explanation must be hard to vary
- Theories organize data and help predict new data

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Evaluating Theories

- Validity:
  - Accuracy of the theory in predicting outcomes
- Parsimony:
  - Simple theories are preferred
- Usefulness:
  - The value of the theory for practical problem solving

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Types of Theories

- **Inductive theories**: built on strong data base and tend to stay close to the data
- **Deductive theories**: logically derived rather than derived from the data
- **Functional theories**: about equal emphasis on inductive and deductive processes
- **Models**: an analogical representation of reality

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Models in Science

- **Model**:
  - A simplified representation of something
- Used to conceptualize phenomena that are too complex to understand in their entirety
- The closer a model is to reality, the more likely that it will be useful

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Different approaches to Science

- Naturalistic observation
- Correlational approaches
- Experimental methods
- Modelling
- Retrospective or post hoc methods

- Qualitative methods

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Other Methodologies

- **Quasi-experimental or Differential research** Comparing existing groups to see if they differ
- **Survey research** Asking respondents to answer questions on questionnaires, inventories, and tests
- **Case study research** In-depth research of a single individual or a few people without any manipulation of the environment
- **Longitudinal research** Monitoring behaviour of a group over an extended period
- **Archival research** Using existing information (e.g., documents, newspaper reports, etc.) to address behavioural issues

WHAT IS ACCEPTABLE RESEARCH?

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What is acceptable research?

You're generating UNDERSTANDING → *consisting of* → New explanation (concepts & relationships)

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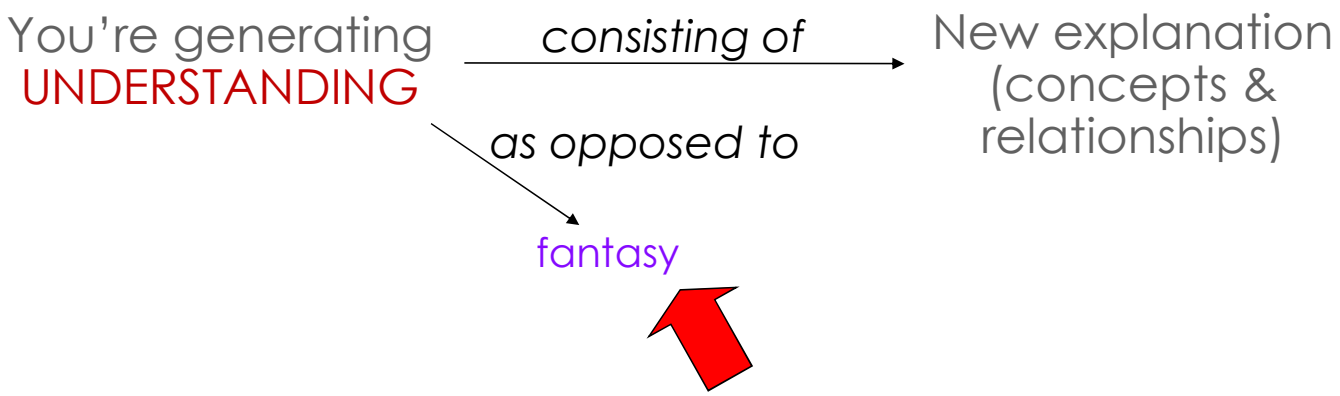
What is acceptable research?



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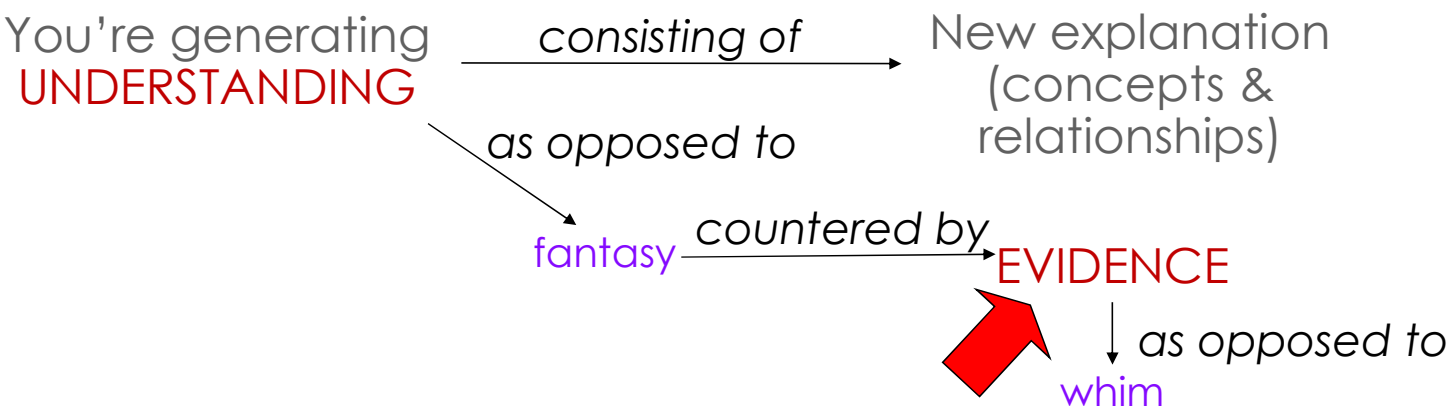
What is acceptable research?



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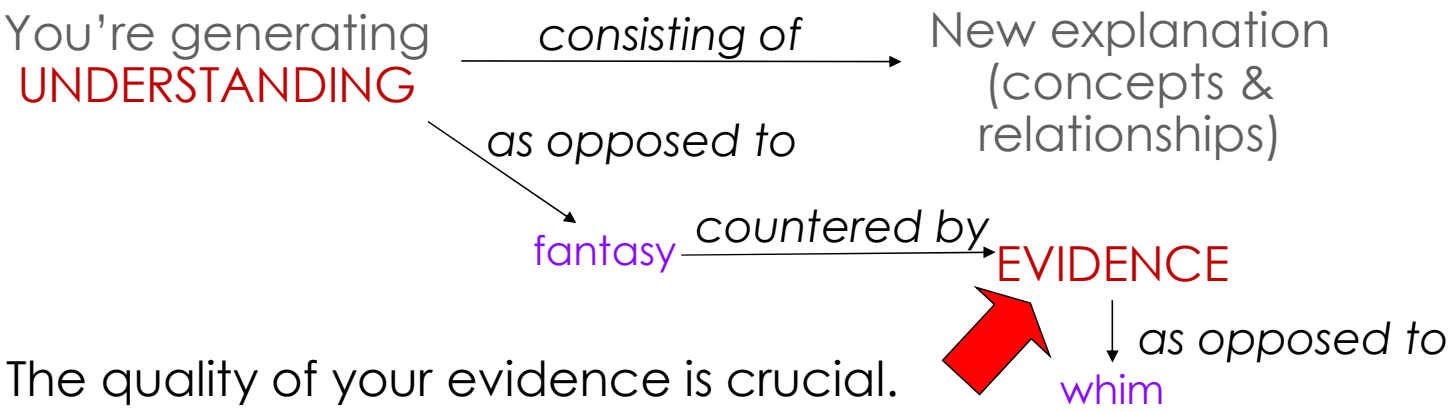
What is acceptable research?



- The quality of your evidence is crucial.
- There are approaches designed to encourage the generation of good-quality evidence which you should follow (whether using qualitative or quantitative research techniques).

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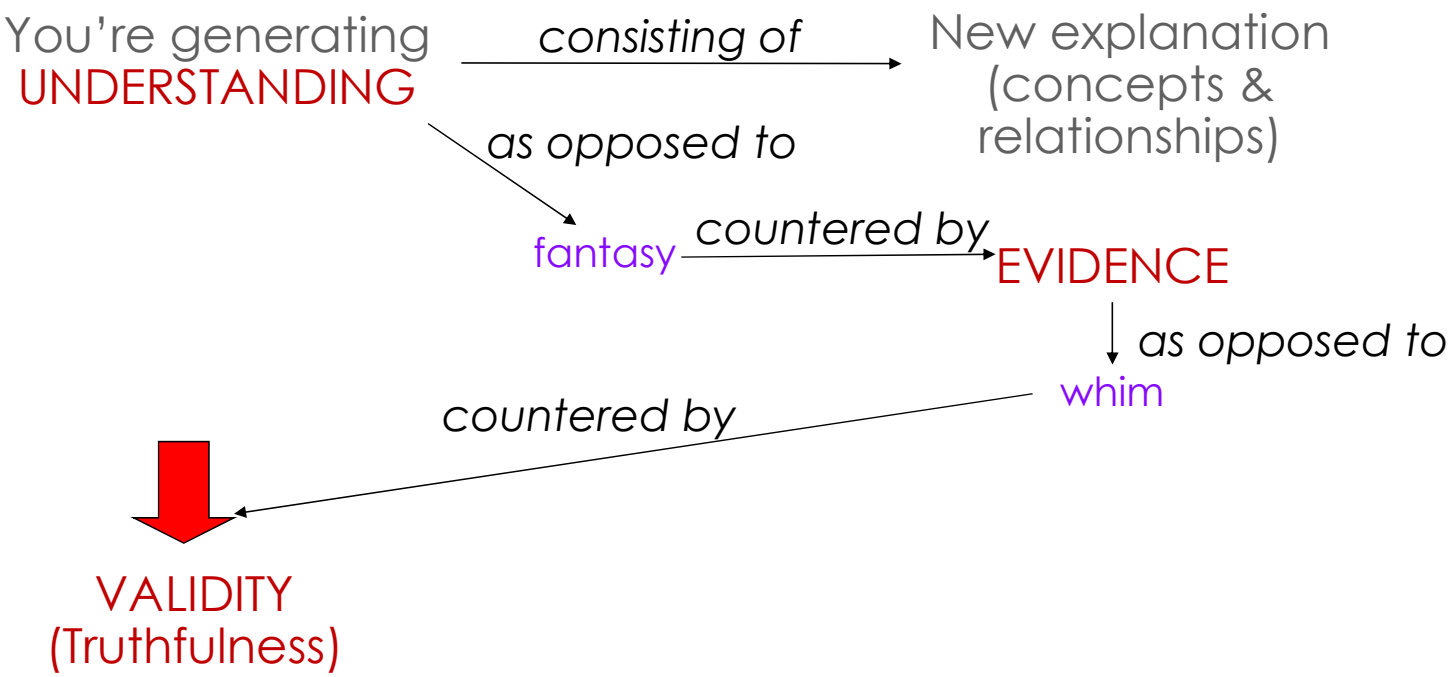
What is acceptable research?



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Validity (internal)

- The extent to which what you are measuring actually relates to what you say or think you are measuring
- Ensuring that your data and interpretation do indeed map onto to the concepts and relationships between them that you say they do.
- *How might your data/interpretation lack validity?*

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Data / interpretation may lack validity

- You base conclusions about "the weather" based on data collected only in summer.
- You interpret interviews in such a way that the interviewees consider that you are misrepresenting them.
- You make generalisations based on a statistical test using data that do not fulfil the criteria required for that test.

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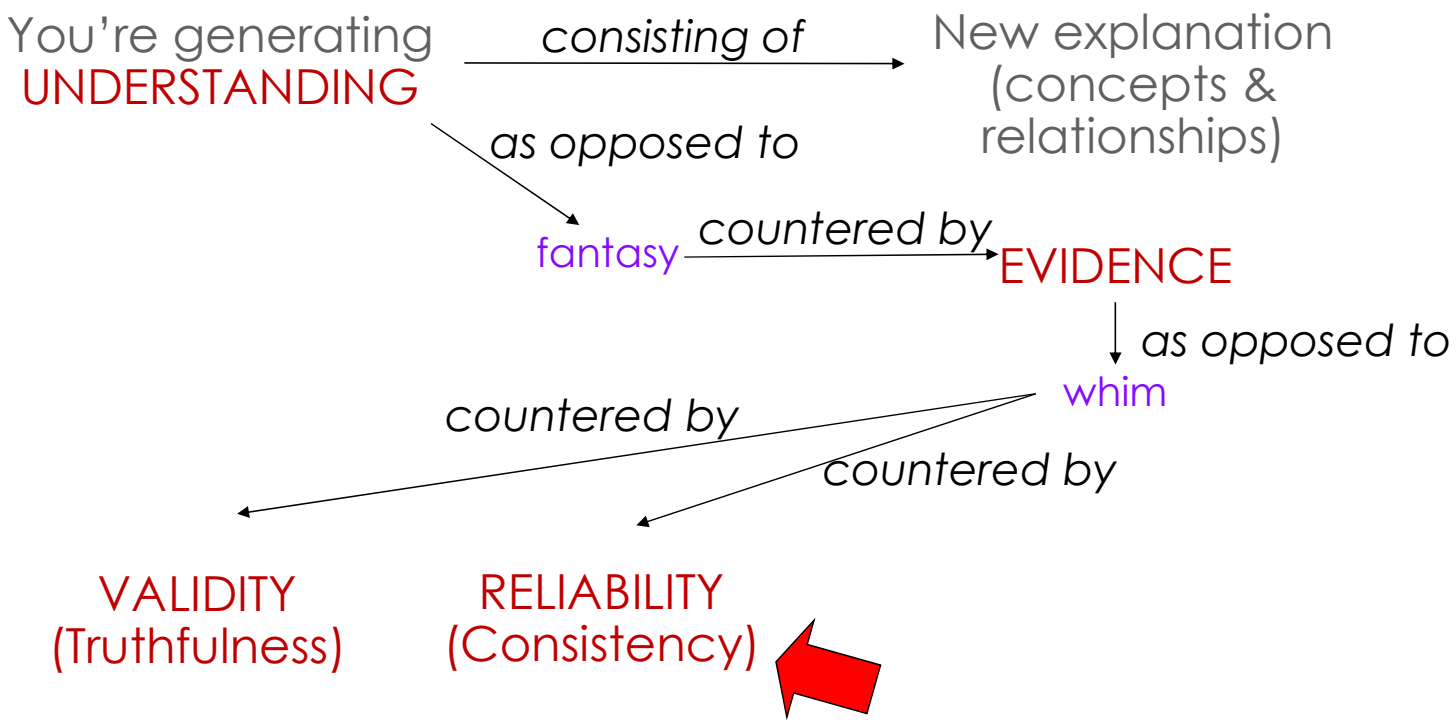
What is acceptable research?



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Reliability (consistency)

- The extent to which a measuring procedure will give you the same results when used on different occasions
- Avoiding volatility or inconsistency – in relation to your research methods and your interpretation of the data.
- *How might data/interpretation be unreliable?*

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Data/interpretation might be unreliable

- Your interpretation is not consistent – you change your criteria for analysing your data half way through your study, but do not acknowledge the implications.
- You allow the conditions in which data is collected to change in some way that may affect the data.

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Qualities of your evidence

Note that:

- Reliability does *not* imply validity
  - An inaccurate ruler would be extremely reliable but not valid.
  - *Same measurement each time but wrong!*

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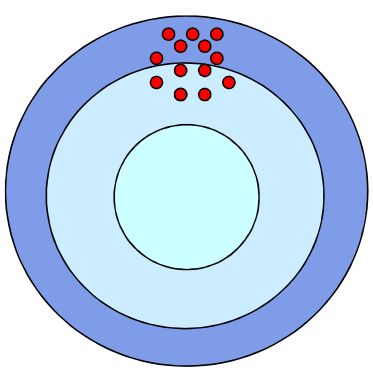
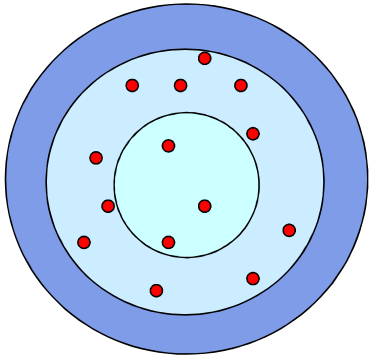
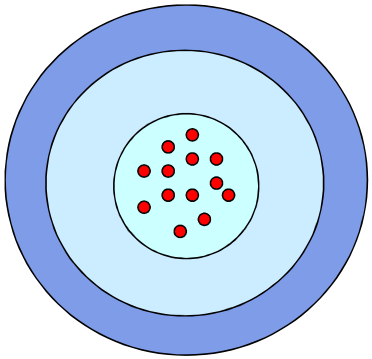
Qualities of your evidence



Reliable
but not valid



Valid
but not reliable



Valid & Reliable

Adapted from: Babbie, E. The practice of social research. Belmont, CA:Wadsworth, 1998

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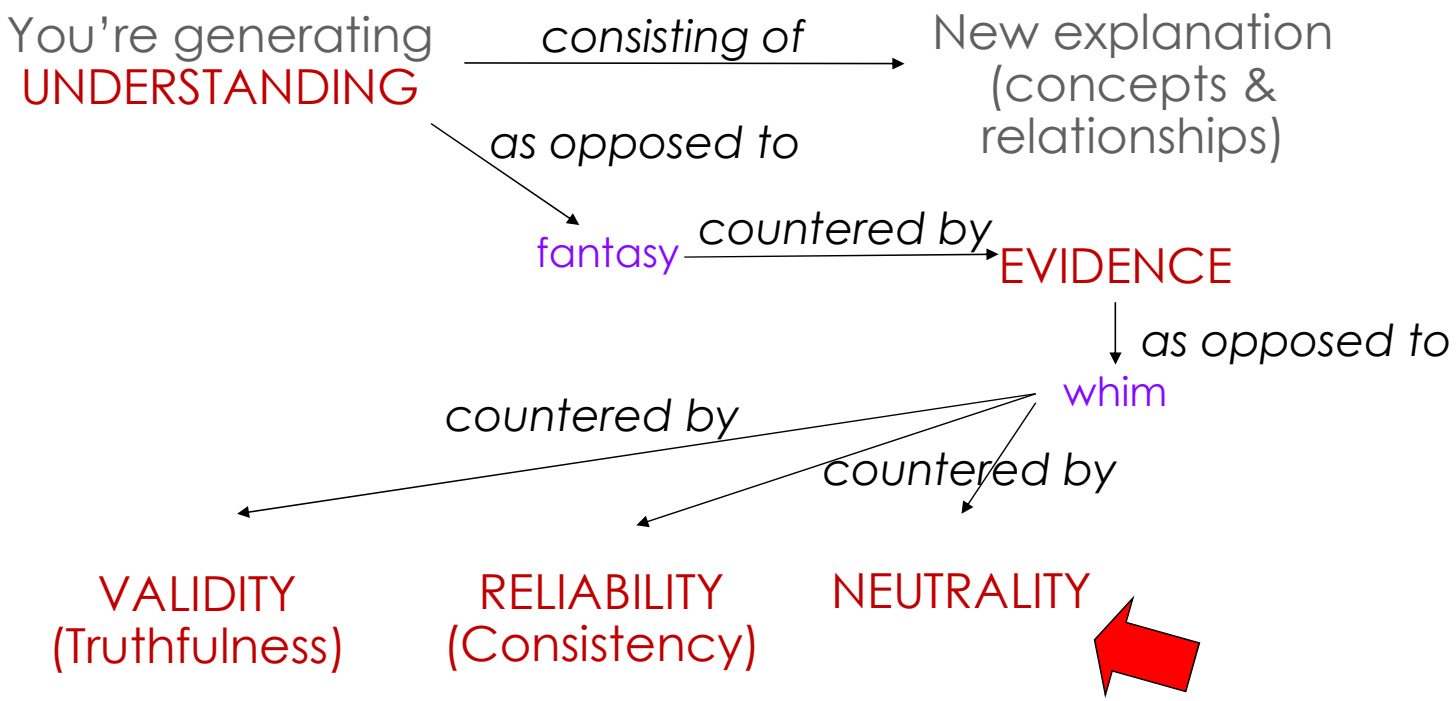
What is acceptable research?



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Neutrality/Objectivity

- Control experimental conditions to avoid subjectivity
- Use instruments that measure objectively and reliably
- Avoiding bias in your data and interpretation.
- *How could the data lack objectivity?*

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Neutrality/Objectivity

- You ignore data that does not fit your "pet" interpretation.
- You send out to interviewees a "hidden message" indicating to them what you would really like them to say.

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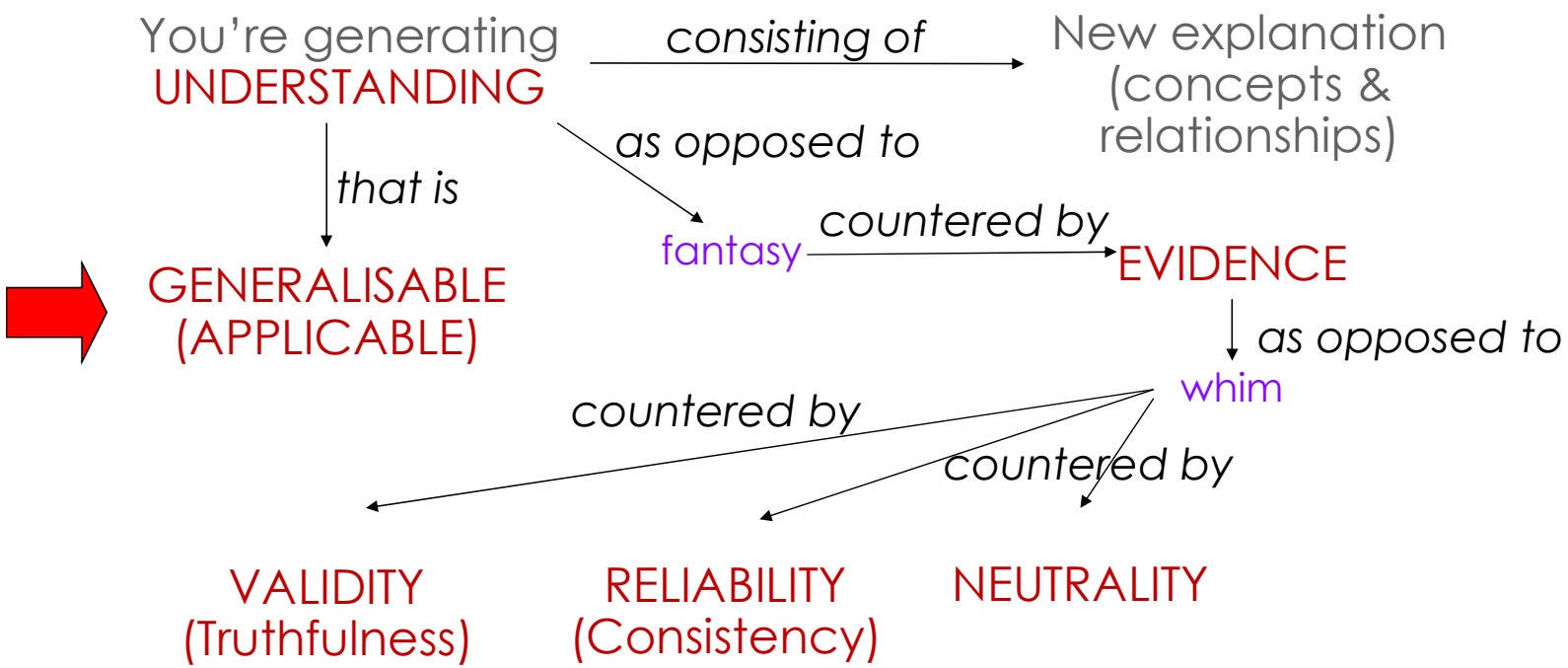
What is acceptable research?



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Generalisability (Transferability or External Validity)

- You maximise the likelihood that your findings will apply to other cases where the same conditions apply.
- The way in which your findings will be generalisable may differ according to your methodological approach...
- As may the way you address issues of truth, consistency and neutrality.

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Examples of lack of generalisability / transferability

- Your data violates a requirement in a statistical test which invalidates the generalisation you claim based on your analysis.
- You fail to include data/information that would enable your findings to be generalised to other cases to which they are potentially generalisable.

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Ethical Principles

- Research ethics is an integral part of modern science
- All researchers should
  - Understand ethical obligations
  - Respect those obligations
  - Carry out research in an ethical manner

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Human Research Ethics

- Formal Ethical Codes
- All research proposals must be approved by an Institutional Review Board
- First safeguard is "informed consent"
- The greater the potential risk to participants, the greater the responsibility of the researcher to protect participants

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Ethical Issues

- Deception
  - Should use only if non-deceptive methods would not work
  - Debriefing is required when deception is used
- Invasion of Privacy
  - Sensitive information must be protected (GDPR)
- Informed Consent
  - The participant elects to be in the study after he or she is informed about the nature of the study

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Ethical Principles

- Other ethical obligations
  - Present data accurately
  - Interpret data fairly
  - Never participate in selective withholding of research data