

**PSYC1001 NOTES**

## **SCIENCE AND STATISTICS**

## LECTURE 1

**c. Identify and understand the logical errors: 'Argument from authority' and 'Ad Hominem'**

**d. Distinguish between open-mindedness and unbounded credulity**

**e. Understand the 'attitude' of scientific investigation**

Stephen Jay Gould - science and religion as "non-overlapping magisteria"

- Cannot move from realm of opinion to science to opinion without evidence

Acquire knowledge through revelation, emotions/intuitions/opinions and the scientific method (may be in conflict with these)

*The scientific method*

- Process, attitude
- Tennis example
- Process of criticizing and evaluating evidence, and proposing and testing alternative explanations

*Reflexive*

- Operates with assumption that our current understanding is imperfect
- Every scientist motivated to disprove old theories because of a realisation that the current understanding is not the best
- If criticism is not possible then progress cannot be made
- All about criticism and progress
- Science must be content with uncertainty
- Science must constantly be critical and re-evaluate to disprove and prove - self-correct
- Science is not a collection of unchanging truths - it is a collection of theories that are the best we have at any given time
- Needs to be transparent and open to criticism
- Closest approximation to truth
- Science ideally has no authority or sacred knowledge which is beyond criticism
- Needs to be cycle of criticism, bettering, development - Eg the germ theory of disease
- Even if past theories not correct, earnest attempts at furthering understanding admired, strong historical respect

*Pseudoscience* - no faith that leading theory is the best = leads to pseudoscience

- 'Alternative' - implies correct but not always

Research = spot bias, industry intervention, logical errors, lack of evidence, lack of peer review,

lack of replication, poor research design, emotive claims etc.

Evidence need to be objective, replicable, peer reviewed, applicable up to date, scientific

### ***Appeal to Authority***

- Logical fallacy
- If you believe something is true because someone important said/endorse it

### ***Ad Hominem***

- Logical fallacy
- Disagree with what someone says but attack them for being of low status or disreputable rather than attacking their claim or evidence

### ***“open-mindedness” vs “closed mindedness”***

- Science should be open-minded – achieved by critical nature
- Accusing someone of being closed minded can be an ad hominem
- A willingness to explore new ideas does not mean you have to accept them unconditionally
- Close-mindedness confused with credulity
- Open-mindedness should be having an evidence filter
- 

\* Eg of a scientific psych theory - Localisation of Function - idea that diff parts of the brain control diff things - body maps emerge - physical body represented elsewhere - used in a diagnostic sense - Body maps only exist in brain - Primary Motor Cortex

### **Readings:**

\* Book Chapter: "The Fine Art of Baloney detection", from the book "Demon Haunted World" by Carl Sagan

\*Non-overlapping magisterial wiki and the article by Stephen Jay Gould on the PSYC1001 Library website

\*V.S. Ramachandran. Phantoms in the brain: human nature and the architecture of the mind /

Chapter 2 : Knowing where to scratch.

\*YouTube video: Open- Mindedness by Qualia Soup

When looking for explanations/examples of logical fallacies: <http://www.skeptdic.com/>

## **LECTURE 2**

- Understand the need for precision in scientific constructs and concepts**
- Consider how each concept or construct we use in Psychology needs to be conceptually defined and established**
- Identify and understand the logical errors: ‘Reification’ and ‘the pragmatic fallacy’**
- Appreciate the notion of ‘falsifiability’**
- Understand what an ‘operational definition’ of a variable is, and why it might not always be ideal**

## **Scientific Constructs and Concepts**

- A construct is an idea or theory often expressed as a single word, but containing lots of assumptions, and conceptual relationships.
- Naming something makes it seem real and valid, but we need to ensure the constructs and concepts we use do correspond in some way to reality, and are actually useful.
- *Pre-scientific constructs*: Cold and hot 'energies', spirit forces, a pinch
- *Scientific constructs* - More accurate but not necessarily perfect approximations of reality - better approximations of reality because they are more accurate, and they arise from a more accurate understanding of the world – E.g. Degrees centigrade, time in seconds, energy (heat, kinetic), structures (atom, molecule), process (reaction, conduction), life (ecosystem, food chain, DNA)
- Constructs we often see in advertising - lack of meaning = it should become clear that care needs to be taken when creating and using constructs
- Adjectives with no meaning or a misleading meaning - Anti-aging, natural, chemical free, fat free
- **Need for precision**: In science we use constructs to make predictions. In Psych, careful instruction in research method and statistics
- Some psych constructs – memory, intelligence, personality, attitude, consciousness, mood, motivation, arousal- how do we measure them? How do we know if they're real?
- Conceptual definition and an operational definition
- A **conceptual definition** involves describing a construct in terms of what it is and what it is not and how it might relate to existing theories.
- Also requires careful consideration of how theoretically useful a construct is.
- Define variables in terms of other concepts (eg stress: a state of strain, whether physical or psychological')
- An **operational definition** of a construct is an explanation of how that construct might be measured.
- Given there are any number of ways to measure a construct, there are any number of ways a construct might be operationalised.
- Can be measured, observed
- BUT: Just cause measure doesn't mean real, Don't confuse the op def with the construct (eg intelligence is what intelligence tests measure), The op def might be a good or bad way to observe a construct (self-report scale, direct measurement)
- - They key difference from the lengthy theoretical considerations of a conceptual definition, is that an operational definition involves finding a way in which the construct can be observed
- You can use your understanding of the operationalization of constructs to critique research.

\* Self report scales - Tapping subjective appraisal. Do we have insight into emotions, how we behave

## **Reification**

- Logical Error
- Occurs when a purely analytic or abstract relationship is treated as if it is a concrete entity
- It can occur when an adjective is treated like a noun. E.g. Energy, evil, luck

'Vitalistic' thinking

- In childhood, and some continue into adulthood
- Unscientific relations, perfect world
- Adults who use more 'vitalistic thinking' more likely to believe in ghosts, luck, telepathy etc.  
– Lindeman and Saher 2007
- Misunderstanding of energy = endorse these
- China (chi/qi), Japan (Ki), Indian (PRANA), Western Europe (Homeopathy: Subtle energy), Western Europe (Animal spirits – the flow of animal spirits carried our thoughts, but after 1828 vitalism begins to disappear in the West)

### ***The Pragmatic Fallacy***

- Logical Fallacy
- Something is true because it works
- When conceptual reality is crudely tied to efficacy
- Evidence (Eg acupuncture works) = theory (eg Chi flows through body and must be unblocked OR the needles excite the parasympathetic nervous system OR Placebo effect)

### ***Falsifiability***

- Everything must be able to be assessed or measured to tell if it is real or disprove it
- Constructs, theories and individual predictions can all be un-falsifiable which means progress cannot be made with them and they are arguably beyond the realm of science
- Freud and the Psychoanalytic approach to psychology are used as an extended example of explanations which are fascinating, but hard to falsify and hard to distinguish between.
- Psychology cannot afford to be vague or equivocal when we want it to progress as other sciences do.
- Chelmsford Hospital - the key tragic event which led to the registration of Psychologists
- Science is not "blind empiricism", happy to measure almost anything as if it is real, and ignore existing scientific knowledge. New scientific research is constrained by existing knowledge through the competitive process of applying for research grants. If a theory or construct has repeatedly been shown to be false, un-falsifiable, or useless in making predictions, the research project will not get funded.

### ***Definitions in Psychological Research***

#### ***Self-Report***

#### **Readings:**

- \* Lindeman, Majaana: Vitalism, Purpose and Superstition
- \* Kosinski, M., Stillwell D.J., Graepel T (2013) Private traits and attributes are predictable from digital records of human behavior. *Proceedings of the National Academy of Sciences (PNAS)*.
- \* Chelmsford Scream

### **LECTURE 3 – Research Design**

**a. Identify the flaws inherent in 'anecdotal' evidence, and why a 'case study' provides more meaningful data**

**b. Understand a correlation coefficient and be able to interpret its meaning in a**

research paper

- c. Appreciate the need for a control condition in ruling out alternate explanations
- d. Be able to distinguish between 'true experiments', 'quasi-experiments' and correlational studies, and understand the pros and cons of each
- e. Use the concepts of 'random allocation' and 'random selection' to distinguish between different kinds of research design and understand 'external validity' and 'internal validity'
- f. Understand the importance of 'blindness' and 'replication' in scientific research

Research Design

- Need to distinguish between different types of designs
- Anecdotes and case studies
- Correlational Studies
- Quasi-Experiments
- True Experiments

### ***Anecdotal Evidence (Flaws)***

- Anecdotes are interpreted stories about a single occurrence in the past and are usually of no scientific value.
- Small sample size
- Built-in bias - Only relevant info to interpretation is reported
- Can change with each telling
- Because often of a single instance, cannot be replicated by a non-prejudiced observer
- A compact piece of info which contains a biased hypothesis, data collection and conclusion
- Usually contains an interpretation
- Hyp and con al in one, cannot go back as it's already biased
- Anecdotal evidence is not data

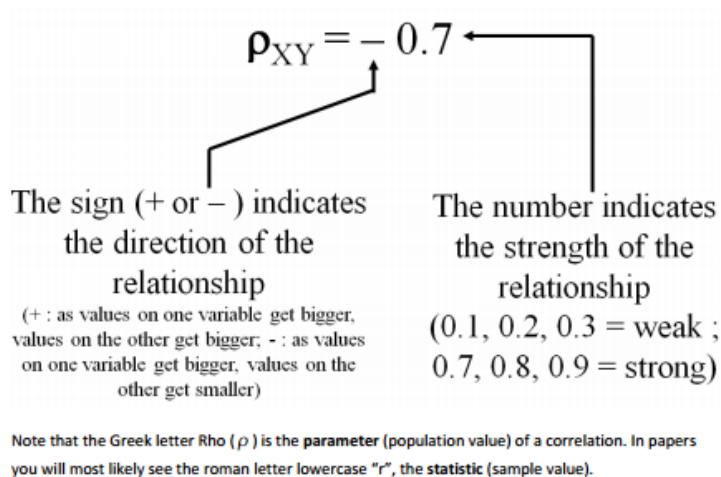
### ***Case Study***

- Significantly more systematic because they arise from an earnest attempt to understand – all details (relevant or not) are recorded in scientific manner
- Small sample size but the unbiased recording of all info means never irrevocably linked to an explanation
- Scientific humility – attitude of wanting to discover rather than confirm = objective notes = alt. explanations possible later
- Often only way to study extremely rare conditions

### ***Correlational Study***

- At least two variables are measured from each case/person with a view to calculating a relationship between variables
- Measurements simply taken, nothing manipulated = difficult to know direction of causation or if any causation
- If variable X is correlated with variable Y, then X could cause Y, Y could cause X, or another variable Z, could cause both X and Y and X and Y are otherwise unrelated
- No control over any variable; all DVs
- Cannot infer causation

- If correlation, a third variable is involved
- Measurement bias - correlation cause weren't measuring variable
- Pattern expressed as a correlational coefficient - 'r' - sign (+ means both go up, - means one goes up while other goes down), number between 0 and 1, higher no. means stronger
- Scatterplots
- **Correlation Coefficient:**



- Scatter plots - The sign gives the direction of the slope, and the magnitude is how clustered the cases are along the line.

### Control Condition

- First essential requirement in inferring causation
- Exists to rule out other causes such as time, fatigue, immune system
- Hamburger e.g.
- Experimental condition – only one controlled feature – if changes found in this and not control then can attribute to manipulation

**IV** – Presumed cause, manipulated. You can think of manipulation as *control* over a variable such that participants can be *randomly allocated* to levels of the variable

**DV** – measured to see if IV has effect. Often a behaviour or response.

### Random Allocation

- Occurs when participants in a study arrive at the study *not belonging to any level of the Independent Variable* and can be given/administered or placed into a level/condition of the Independent Variable by a random process. Complete control over the independent variable to be randomly allocated is necessary.
- Hard to randomly allocate – treatments, lifestyles, education, experience, diet
- Impossible to randomly allocate – Sex, brain damage, psych disorders, sexuality, family, location, religion, race, income

### Random Selection

- Completely irrelevant
- Will only appear as a distractor

### **True Experiment**

- All IVs of interest are controlled and able to be randomly allocated
- A strong causal inference can be made because random allocation makes all variations between the groups cancel out
- If a difference is found in the dependent variable in a true experiment, you can make a strong conclusion that differences in the independent variable caused that difference

### **Quasi-experiment**

- At least one key variable of interest cannot be randomly allocated, but others can
- Pre-existing groups = confounds which weaken causal inference
- At the end of the study if you find a difference in your DV between people belonging to one pre-existing group over another, you can't say with certainty what caused that difference
- Most common kind of research design in many fields of Psych
- **Matching:** Trying to equate pre-existing groups with control groups = systematic differences caused by that variable can be ruled out.
- With random allocation you do not need to even consider co-variations because all of them cancel out
- Bias will cancel out until only systematic difference between groups is IV
- Match on every factor except one being tested
  
- !!! In exam, a quasi-experiment will be flagged by the use of matching, *or* the fact it involves random allocation of some variables but not others. Stay focused on the question of "How many independent variables of interest are randomly allocated?"
- Understanding random allocation and control over variables is key to classifying each study as either a correlation study, true experiment or quasi-experiment

#### Random allocation of independent variables

- Correlational study : NONE
  
- Quasi – experiment : At least one (but not others); or none, but some attempt to control one (e.g. matching)
  
- True Experiment : ALL

### **External Validity**

- The extent to which finding can be generalised to the population at large
- It can depend on:
  - o Sample size
  - o How the sample was chosen
    - ♣ Was random sampling used? Did participants self-select for the study? Is the sample likely to be biased?
  - o Where and how the experiment was conducted
    - ♣ How artificial was the testing location? How real did participants think it was?
  - o How variable the effects being studied are
    - ♣ If the effect varies very little from person to person a large sample might not



be needed. If an effect varies greatly across cultural groups, they need to be represented in the sample.

### ***Internal Validity***

- The extent to which changes in the DV can be attributed to changes in the IV
- If strong causal inference made – internal validity is high and vice versa
- True experiments high, correlational studies low

\* Can vary independently

### ***Blindness:***

- Essential in research
- Both researchers and participants should be blind to which condition is being administered – ‘double blind’
- Participants and researchers knew conditions they were allocated to = undermine results
- Participant would guess what is expected, research may not randomly allocate correctly or incorrectly record data

### ***Replication:***

- Same findings found by independent party following the same method
- = Methods need to be detailed

### ***Reading:***

\* Taylor, James. Efficacy and safety of Echinacea in treating upper respiratory tract infections in children: A randomized controlled trial.