Introduction to research methods in Psychology

Research methods

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Research methods

Three lectures, 4/5/10 March

Recommended reading

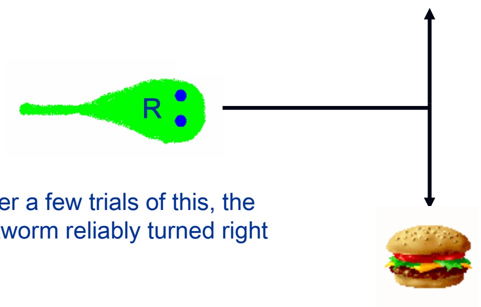
- Textbook Chapter 2
- Laboratory One in your lab manual (week starting 31 March)
- One page summary handout on Cecil
- These lecture .ppt slides are also on Cecil – two files

The textbook's pretty good for this section, but see it mainly as background reading – I won't ask you anything in the exam that wasn't in my lectures or the handout

A research cautionary tale

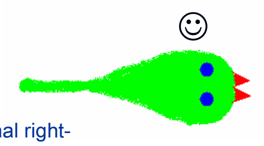
- Not examinable, just a story (though it's a true one)
- About 40 years ago, lots of interest in the physical representation of memory in the brain
- The search for the engram
- Researchers did an experiment with flatworms, or planaria, to try to prove that memory was stored physically in the brain
- Would memory transfer from one flatworm to another?

Training a flatworm to turn right …



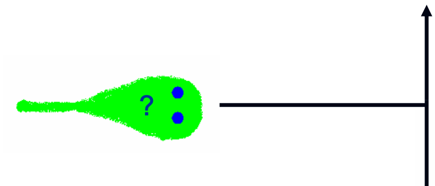
After a few trials of this, the flatworm reliably turned right

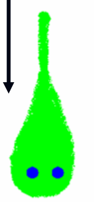
Feed the right-trained flatworm to a new flatworm



A really silly idea – if the original right-trained flatworm had a memory of "turn right", and that memory was physically represented in its nervous system, then the second naïve flatworm has **eaten the memory**

So test the second flatworm in the maze …





Believe it or not, flatworms that had eaten right-trained flatworms consistently turned right as well

But …

- Since the original flatworm experiment, there have been many attempts to **replicate** it (do it again and see if we get the same result)
- **None of them have been successful**
- What was wrong with the original study? Was it:
  - Well conducted but a fluke result?
    - The role of **statistics** is to allow for this possibility – that's why you have to take a Statistics course to major in Psychology (see also my third lecture)
  - Flawed because it was badly conducted?
    - The role of **research design** is to prevent this, and that's what these lectures are about

Basics

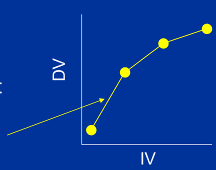
- Research is process of asking questions about the world
- We all do this – we're all researchers really
- Good research design is a formalised way of asking questions so that we're sure the answers will mean something
- Most of you won't go on to be **producers** of research (although I hope you will), but you are all already **consumers** of it
- I'd like to make you more sophisticated, cautious, sceptical, suspicious consumers

Basics

- Same principles apply in all research (physics, biology, history)
- But there's a particular ethical obligation to make sure that psychological research is done well
  - Our subjects are usually people, and we have a duty not to waste their time
  - Results of psychological research are often applied to how people are treated, so we'd better get it right
- Most of a Stage I course in anything is about learning the words used in the field so you can learn the content more efficiently, so …

Terminology – DV and IV

- **Dependent variable** (DV)
  - Measure of the behaviour we're interested in
  - Goes on *y* axis of a graph of our results
  - e.g., reaction time in mental rotation experiment
- **Independent variable** (IV)
  - Variable manipulated by an experimenter to see if it affects the DV
  - Goes on *x* axis of a graph
  - e.g., rotation from vertical of target in same experiment



One possible relationship between IV and DV

Terminology – operational definitions

- Both our IV and our DV must be operationally defined
- **Operational definition**
  - A statement of the operations carried out by the researcher to measure the DV or manipulate the IV
  - The Method section of a research report is about operational definitions
  - Helps other researchers **replicate** (repeat) our study
  - Helps us be objective in what we conclude about our research – avoid bias

Terminology – validity and reliability

- Dependent variables need to be valid and reliable
- Validity
  - Does the DV, as operationally defined, measure what we want it to?
  - e.g., is IQ score a valid measure of intelligence?
- Reliability
  - Will you get the same results if you measure the same variable again? – replication
  - Good operational definitions help with this
- Measures are sometimes reliable but not valid
  - e.g., shoe size as a measure of IQ
- They probably can't be valid if they're not reliable

Terminology – sample and population

- Population
  - All the scores, events, etc that we're interested in
  - e.g., heights of the entire PSYCH 109 class
- Sample
  - A representative subgroup of the population
  - e.g., heights of a random selected 10 people in the class
- We usually can't measure the entire population we're interested in, so we take a sample and infer general results about the population from the sample

Terminology – sampling error and sampling bias

- Two ways that sampling can go wrong :
- Sampling error
  - Results of repeated samples from the same population will always differ
  - Unavoidable
  - But you can minimise it by using bigger samples
- Sampling bias
  - Sample misrepresents population in a systematic way
  - Avoid by doing random sampling
  - Serious sampling bias invalidates the research

Examples of sampling error and sampling bias

- Population = heights of the 109 class
- DV = average height
- How sampling error depends on sample size
- Suppose I did a sample where I chose everyone whose first name ends in a vowel to be in the sample – how does this lead to sampling bias?
- Historical example of sampling bias :
  - 1948 US election – phone polls predicted win to Thomas Dewey (Republican), but Harry Truman (Democrat) won easily. Why?

Two general kinds of research design …

- Observational design
  - Measure two DVs and look for a relationship between them
  - Sometimes called a correlational design, because a relationship between variables is a correlation
  - There is no IV, because nothing is manipulated
  - e.g., is self-esteem related to height?
  - Often only choice for ethical or practical reasons
  - e.g., discovery of Broca's area for speech in the brain
  - e.g., your first lab, about sex differences

The basic weakness of observational designs

- Just because two DVs are correlated, we can't conclude that one affects the other
- e.g., suppose we find that watching violent films and aggressive behaviour are correlated
- Maybe watching violent films makes you aggressive
  - A causes B
- But maybe naturally aggressive people like watching violent films
  - B causes A
- Or maybe they're both caused by another variable
  - C causes both A and B
  - Called the third variable problem

The basic weakness of observational designs

- If there's one thing I'd most like you to remember from these lectures, it's :

Correlation does not imply causation

Two general kinds of research design …

- Experimental design
  - Manipulate IV and look to see effect on DV
  - Can imply causation
  - e.g., is self-esteem related to results of a fake IQ test?
  - e.g., Flourens and experimental ablation
- Experimental designs are more powerful than observational, so we should use them when it's ethical and practical to do so
- When you're evaluating research that you read about, always consider this issue – has causation really been proved?

Two general kinds of research design …

- This explains, I hope, why I'm a bit fussy about what an independent variable really is (see footnote in Laboratory One in your lab manual)
- A lot of people, including the author of your lab manual, use 'IV' more loosely than I think we should, to mean 'the variable that caused the changes in the DV'
- But if you haven't done an experiment, then how do you know what caused the changes?
- So Lab One isn't really an experiment, because it compares the behaviour of males *vs* females, a pre-existing variable not manipulated by us
- And sex isn't an IV
- And it's not possible to be confident about causation …

The fundamental principle of research design

- We want to eliminate all explanations of our results except one
- That is, if we conduct an experiment, and see a change in behaviour (our DV), we want to be sure that it was caused by our IV
- Alternative explanations of the results are called confounds or confounding variables
- A confounding variable is anything, other than our IV, that might have produced the change in DV that we saw
- They are bad, and we need to eliminate them if want our research to be worthwhile

General approaches to eliminating confounds

- Hold the confounding variable constant
  - especially good for environmental or external confounds
  - called "standardization" in your textbook
- Randomize the confound
  - especially good for subject-based or internal confounds
- (Decide that they're more interesting and study them instead)

General approaches to eliminating confounds

- You should always think about research that you design and that you read in these terms :
  - What possible confounds were there ?
  - Have they been controlled ?
- If not, don't trust the research

Example – within-subjects *v* between-groups

- Within-subjects design
  - Each subject is exposed to all levels of the IV (all experimental conditions)
  - e.g., does alcohol affect short-term memory?
  - Each subject tries to learn a list of words in both "sober" and "drunk" conditions
  - There is an effect if individual subjects behave differently in the two conditions
- Good for controlling subject confounds
- But there could be environmental confounds – such as ?
- Especially note the risk of an order effect

Example – within-subjects *v* between-groups

- Between-groups design
  - Each subject is only exposed to one level of the IV (one experimental conditions)
  - e.g., separate groups of subject in "sober" and "drunk" conditions
  - There is a difference if the average behaviour of the two groups is different
- Good for controlling environmental confounds
- But could be subject confounds – maybe the people in the "sober" condition just had better memories anyway
- Can partly prevent this by randomly allocating subjects to groups

Other names for these designs

- Between-groups design also called
  - Between subjects
  - Independent samples
  - Independent groups
- Within-subjects design also called
  - Repeated measures

A way to get the best of both designs

- Matched-pairs design
  - Give a pretest on memory ability before the experiment
  - Find pairs of subjects with similar memory ability
  - Randomly allocate one member of each pair to each condition, "sober" and "drunk"
  - There is an effect if the "sober" member of each pair consistently scores better than their "drunk" partner
- Keeps environmental confounds constant, and nearly keeps subject confounds constant too
- This is a very good design, but quite labour-intensive, so it isn't used as often as it should be

Experimental and control groups

- Easily the most common design in Psychology is a between-groups design that compares an experimental group with a control group
- e.g., assessing the effectiveness of a new drug
- The two groups are identically treated in all respects except that :
  - The experimental group receives the treatment
  - The control group doesn't
- One possible confounding variable is subject expectation, so it's important that the subjects don't know which group they're in
- This is a single-blind design

Experimental and control groups

- Another important confounding variable is experimenter expectation – why?
  - The experimenter needs to remain objective
  - The experimenter's expectation might affect how the subjects behave
- So it's best if the experimenter doesn't know who is in which group either
- This is a double-blind design
- Usually thought of as the "gold standard" for research