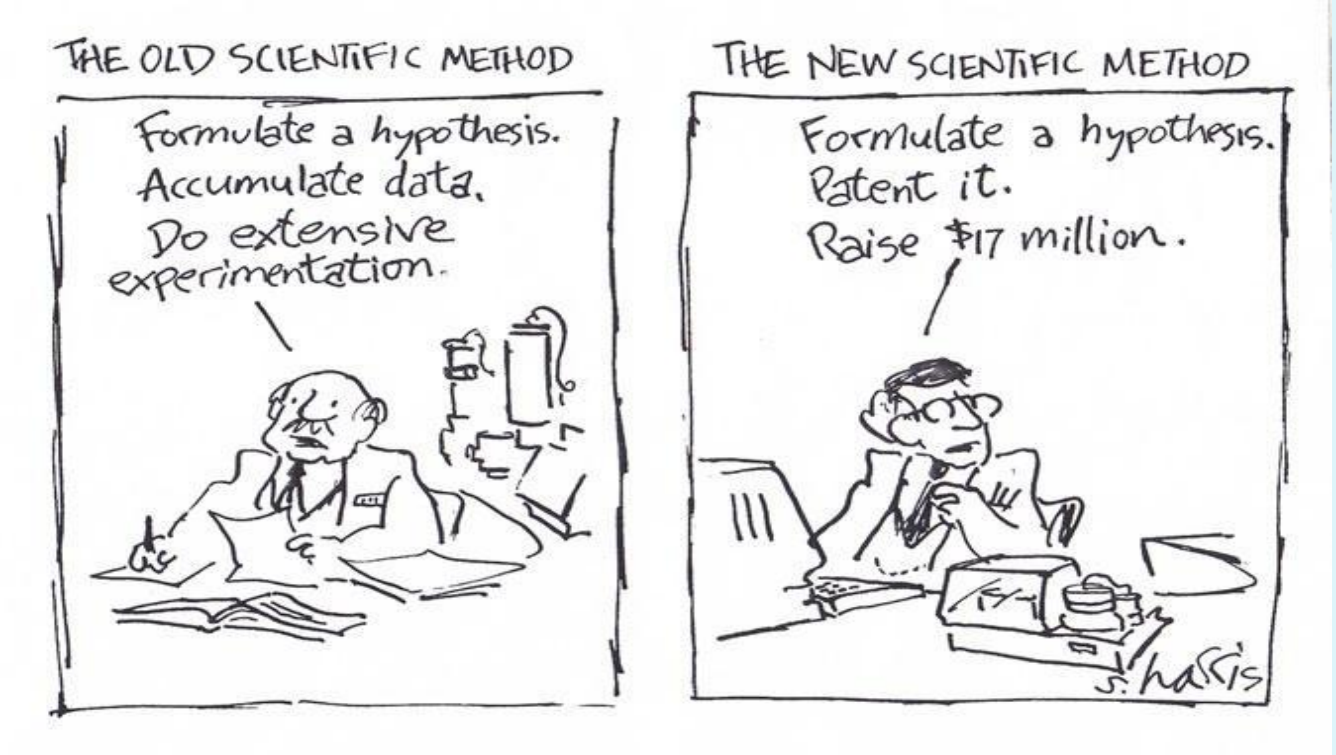
Features of Science



Specification

Students should demonstrate knowledge and understanding of the following scientific processes, be familiar with their use and be aware of their strengths and limitations. Features of science: **objectivity** and the **empirical method**; **replicability** and **falsifiability**; **theory construction** and **hypothesis testing**; **paradigms** and **paradigm shifts.**

Features of Science
Learning Objectives - Need to Know

- Understand and describe the major features of science, be able to explain their strengths and limitations and be able to explain why they are important , including:-
- **Objectivity** and the use of **empirical methods**
- **Replicability**
- **Theory construction**
- **Hypothesis testing** and **Falsification.**
- **Paradigms and Paradigm Shifts**

What distinguishes science from other types of activity?

Scientific Knowledge	Pseudoscience
Strives to be **objective (astronomy)**	Is typically **subjective (astrology)**
Is **reliable**	Can be **unreliable**
Is intolerant of **contradictory** evidence	Can be contradictory, e.g. (many hands make light work, too many cooks spoil the broth). Homeopathy.
Is **replicable**	Can be difficult to replicate because people's common sense insights can be highly individual.
Is based on **empirical evidence** and is **falsifiable.**	Can be based on unchecked evidence (e.g. opposites attract) such as rumour, hearsay and prejudices. Isn't **falsifiable**, e.g. psychoanalysis,.

Objectivity - A01

- A term used to refer to views based on observable phenomena and not on personal opinion, prejudices or emotion.
- Objectivity is the a key feature that distinguishes scientific evidence from other sources of information.
- Objective evidence is gained through objective observation, experimentation and measurement of behaviour and if the method of collecting the data is replicated the data will be the same or very similar.

Objectivity - Activity

- **Below are a series of statements. Think carefully about each one and decide which ones you think are objective and which are subjective.**

1. People who want to understand themselves better should study psychology.
2. Based on 2005-7 data, the mean life expectancy at birth for men living in the United Kingdom is 77.2 years and 81.5 years for women.
3. There are usually more road accidents during the winter months because there are more hours of darkness each day.
4. Girls are more motivated to succeed at school than boys and therefore girls examination performance is better.
5. Research shows a colour name can be read faster when it is written in the same colour ink than when it is written in a conflicting colour ink (the Stroop Effect).
6. Specific eating disorders are far more prevalent in girls/women than they are in boys/men.

Is Complete Objectivity possible- **A03**

- **Popper** argues that complete objectivity is impossible as we all see the world from our own particular viewpoint or biases. This influences the topics we choose to look at and the way we look at them.
- Though this is recognised, objectivity is still regarded as an important feature of science and it is generally agreed that scientific data should be collected as objectively as possible.
- **However, subjective** data is important in psychology. It often comes from individual self reports, which by their nature can't be replicated and though regarded as unscientific they can be extremely valuable to researchers in understanding human behaviour, emotions and thinking, and can lead to the formation of hypotheses for testing.

Replicability and Reliability - AO1 and A03

- In all scientific disciplines, including psychology, it is essential that research can be replicated, so that other researchers can validate (check) each others findings.
- This means a group of peers will rerun the research in exactly the same way the researcher, did if they get different results then the original results will be seen as **unreliable**. If they are the same or very similar they will be seen as reliable.
- **Strength** - This guards against fraud
- **Strength** - It also enables researchers to test if particular results were a one-off fluke occurrence, due to specific features of the procedure, the sample or the environment in which the study was carried out.
- If findings can't be replicated then they can't be applied nor can they be used to support or challenge existing theories.

Theory Construction and Hypothesis Testing

- According to Popper scientific knowledge is the result of theory construction and hypothesis testing.
- Following this process it then becomes possible to generate laws and scientific principles.

Theory Construction and Hypothesis Testing

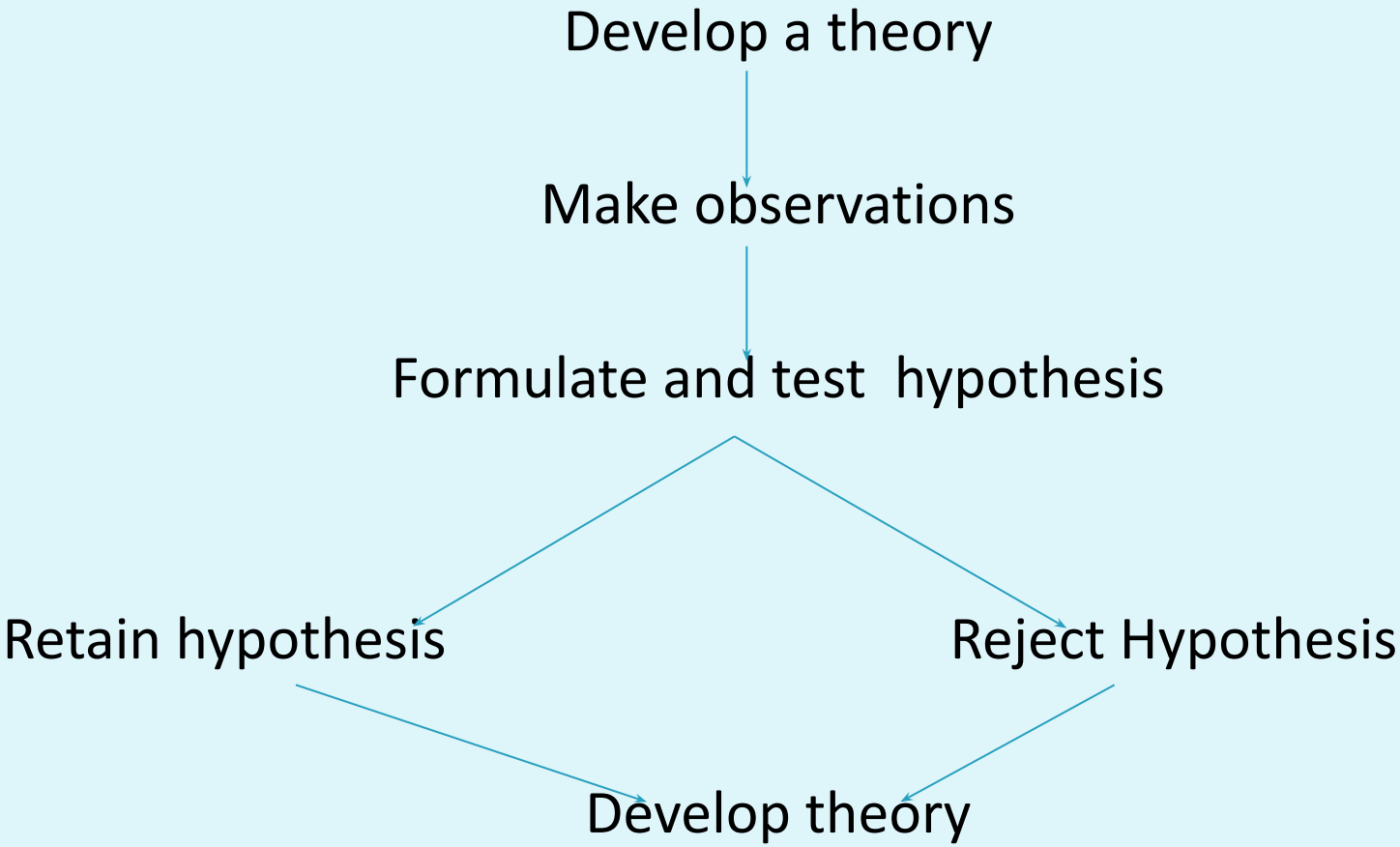
- "No matter how many instances of white swans we may have observed, this does not justify the conclusion that all swans are white". (Popper, 1934)
- Popper's key idea – No amount of evidence can ever "prove" a theory is right, yet it only takes one piece of evidence to disprove a theory.
- If it's truly scientific it should be **falsifiable.**

The Empirical Method – A01

(The Hypothetico-Deductive Method - based on Popper)

1. Identify a problem or a question (from previous research, from observations or even to challenge common sense assumptions – sometimes known as the inductive phase).
2. Develop a hypothesis about the problem. (This should be **predictive** and, crucially **falsifiable**).
3. Design a study to test the hypothesis. (The most empirically based method in psychology is the laboratory experiment which allows cause and effect to be established.)
4. Analyse and evaluate the results to see whether they support the hypothesis or not.
5. Modify and repeat the process in light of stage 4.
6. Develop a theory

Diagram of A01



Hypothesis Testing and Falsification- A01

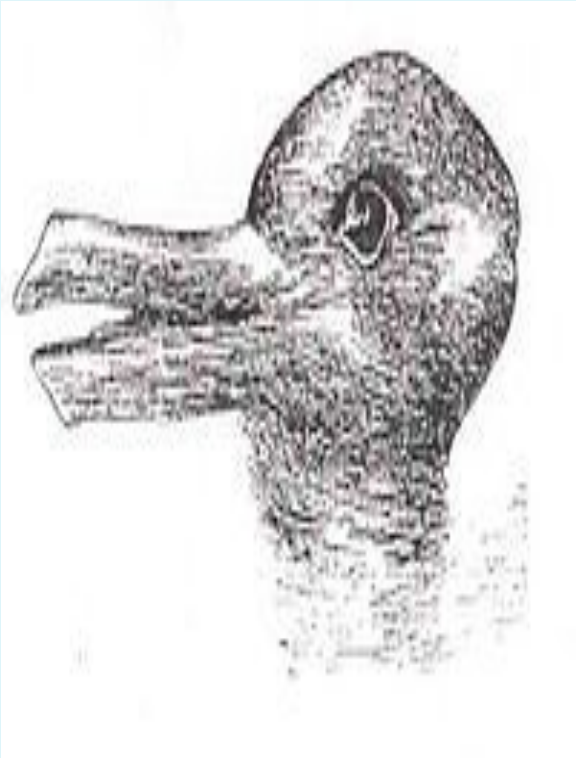
- The crucial element in the deductive method is falsifiability.
- It should always be possible to demonstrate that a theory is false.
- According to Popper, a theory has only been tested adequately if a researcher has tried to show that it is false.
- So, rather than trying to find evidence to support a theory, researchers should actively look for ways of disproving it.
- If many attempts to disprove a theory fail then the theory is strengthened. This doesn't mean the theory is true but that no one has been able to prove it is false. This why psychologists prefer to use words like **supports** or **suggests** instead of **proves.**
- This is also why all research uses a **null hypothesis** as well as an experimental or **alternative hypothesis**

Objectivity and the Empirical Method A01 and A03

- In psychology, though there are many ways of carrying out studies the method regarded as the most scientific and therefore the most objective is **the experimental method** (usually referred to as a **lab experiment**, though it doesn't always take place in a lab)**.** This is based on the doctrine of empiricism.
- **Strength** - Though philosophers of science tell us it is impossible to establish causality with certainty, the experimental method allows us to have some confidence that the IV has influenced the DV, so **cause and effect** can be established. This means objective knowledge is then available to other scientists to check and verify.
- **Limitation –** However it can be difficult to generalise findings from laboratory studies to real life situations as they often use artificial stimuli and people can behave differently in these situations to the way they would in real life.

Paradigms and Paradigm Shifts

- Unlike **Popper, Kuhn** believed scientific progress wasn't the result of steady progress using induction and deduction but of sudden and rare changes in understanding which led to what he called **paradigm shifts.**
- **Paradigm**:- A paradigm is a set of shared assumptions and beliefs about how behaviour is studied and explained, e.g. a focus on biological explanations of behaviour.



Paradigms and Paradigm Shifts

- **Paradigm Shift**:- A paradigm shift occurs when members of a scientific community change from one way of studying and explaining behaviour to a new way because of contradictory evidence.
- A recent example of this would be the change of approach in explaining and researching schizophrenia from biological to interactionist.
- This means rather than focusing on genes, brain structures and neurotransmitters as sole causes researchers are investigating explanations which include interactions between these and cognitive and environmental factors.
- Can you think of any others – doesn't have to be psychology?

Other examples

- Emphasis on causal explanations of behaviour due to evidence suggesting free will is important leading to the cognitive revolution in the 70's.
- Biological gender as an explanation of cognitive style and ability and preferences– increasingly research shows very small differences in male and female brains. Suggests culture plays an important role in gender differences

Psychology as Science

- Ben Goldacre: Battling bad science | Video on TED.com
- How dumb can one company be? – Bad Science

Independent Work

- All independent work to be completed by next lesson unless a specific date has been given. It is not acceptable to miss deadlines.
- All exam questions to be completed on loose leaf paper with name and date clearly written in top left hand corner of page.
- Notes and appropriate folders to be brought to all lessons.
- It is best practice to complete independent work as soon as possible after the lesson.