IST 605: Human Information Processing
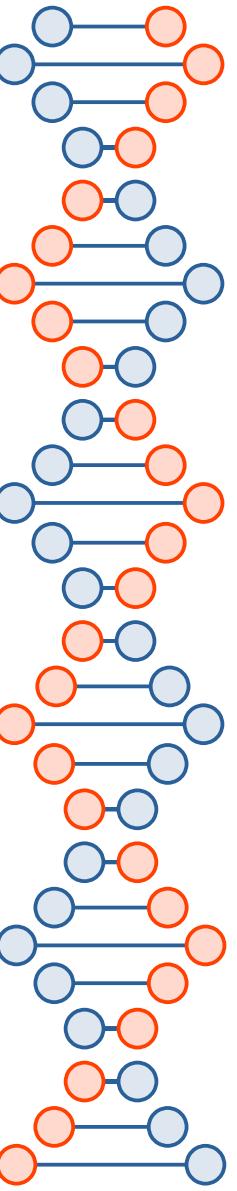
Overview

Denis L. Nkweteyim
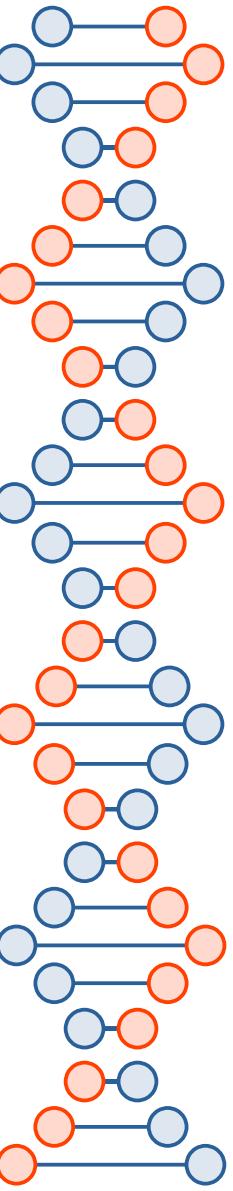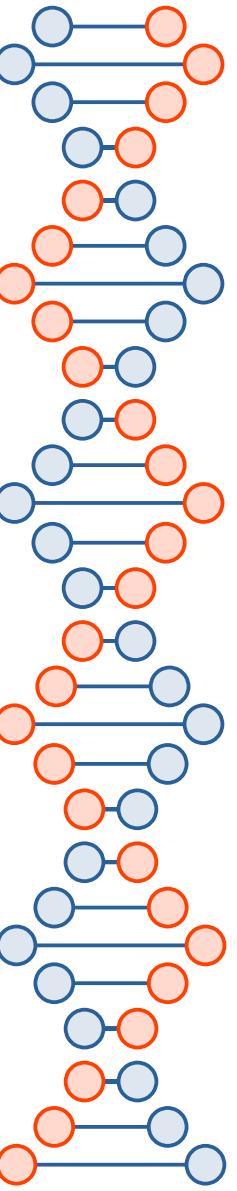
Outline

- Introduction

- Framework for Cognitive Psychology

- Some related issues

  - Learning

  - Experience and Reasoning

  - Memory

- Experience and Experimentation

- Roots of Cognitive Psychology
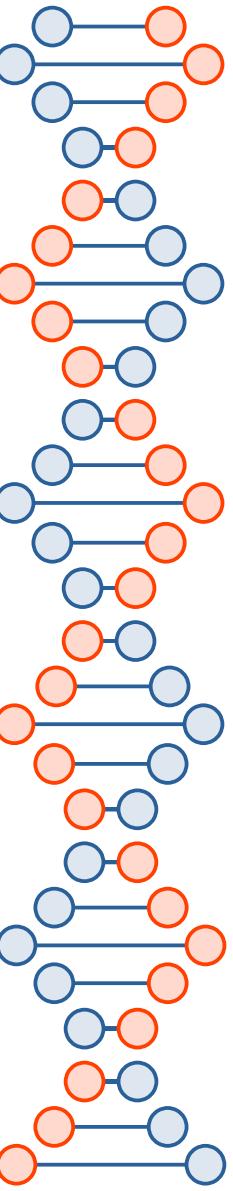
Introduction

- What is Cognitive Psychology?

    - Simply stated, the study of cognition (i.e., thought)

    - i.e., the study of how people perceive, learn, remember and think about information

- Assumptions

    - Individual components of mental processes can be identified and understood

    - Internal mental processes can be described in terms of rules or algorithms in information processing models
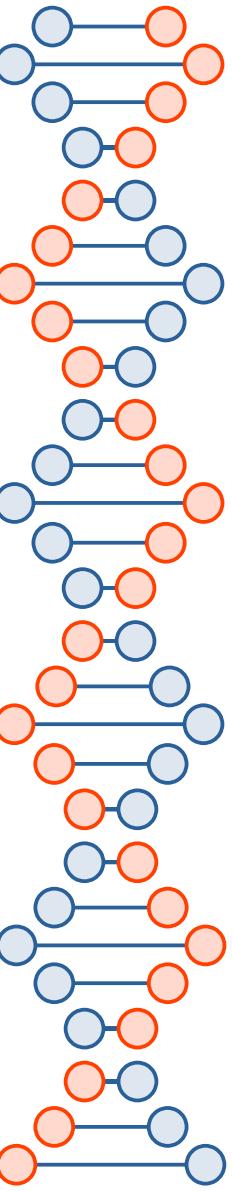
Introduction

- Studies knowledge
  - Acquiring knowledge
  - Organize knowledge
  - Using knowledge

- Topics include
  - Sensation
  - Perception
  - Attention
  - Memory
  - Language
  - Reasoning
 - Problem solving
  - Decision making
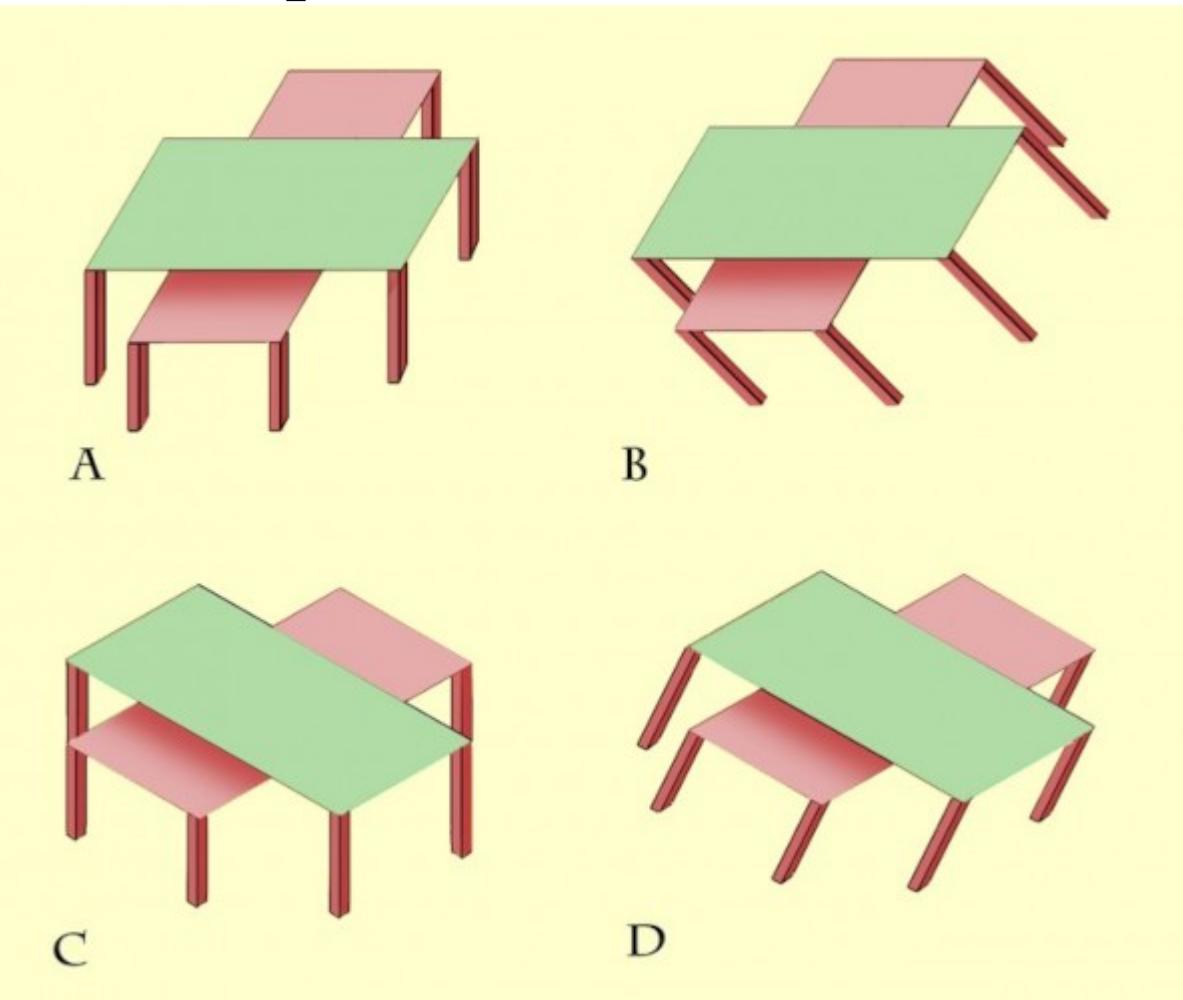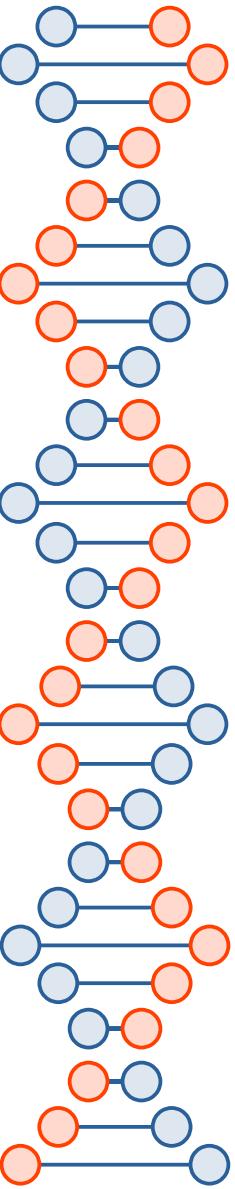
Introduction

- Intuition
  - Relying on our judgment to explain behaviour and thought
  - But intuition is only one source of information to our cognitive system, and sometimes fails and misleads us
  - e.g., Naive Realism – the intuition that perception is simply seeing the world as it is
    - Many studies have shown that this is not the case, for example two sets of people watching the same video of a football match and offering conflicting ideas on which of the teams was more aggressive
    - See next slides for other examples
      - Shepherd's tables illusions – all the tables shown are the same size
      - Shaded objects
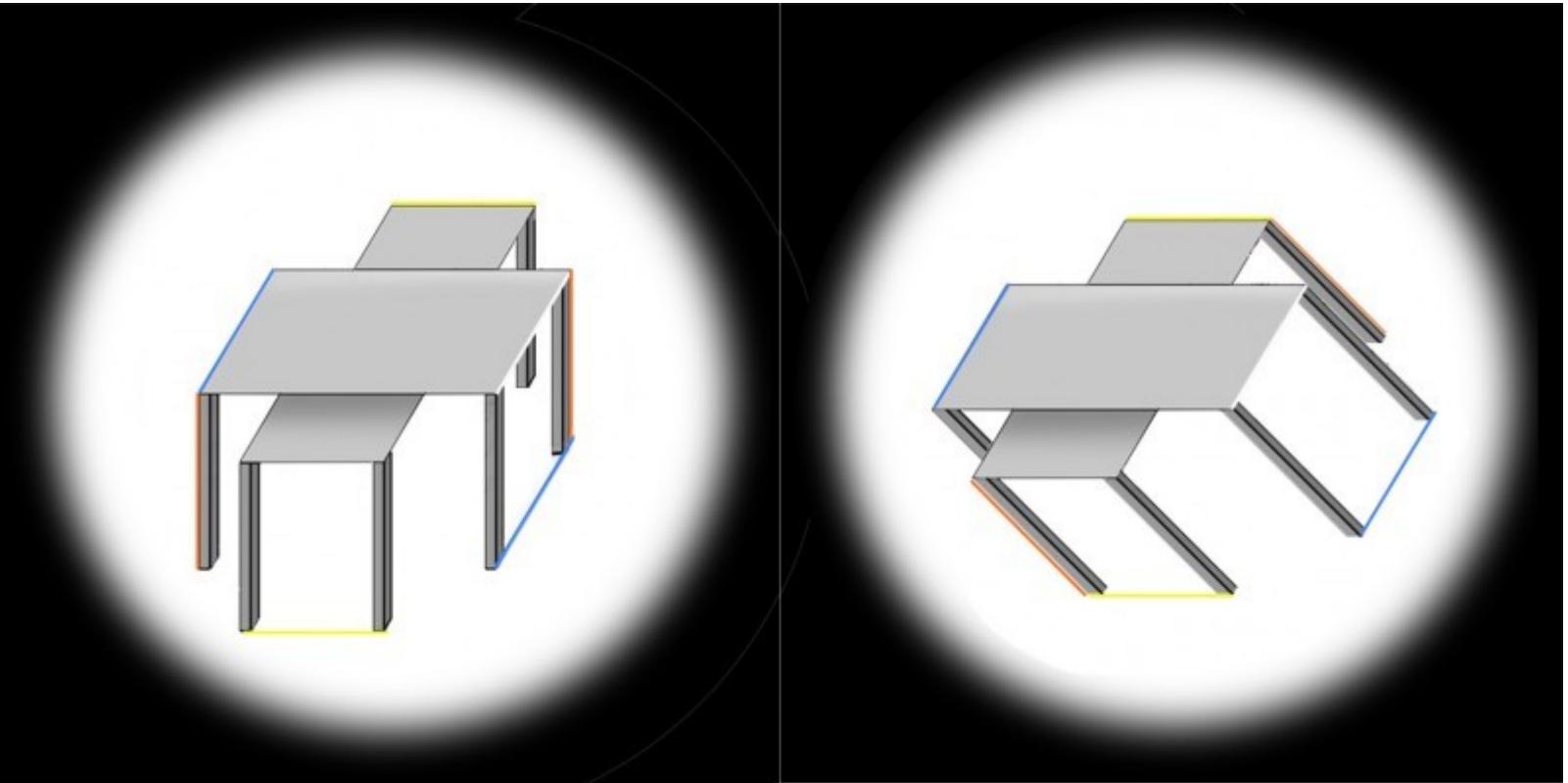
# Shepherd's Tables Illusions I
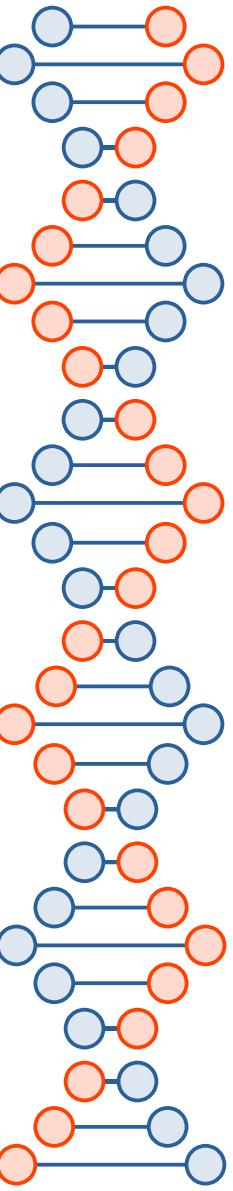
Shepherd's Tables Illusions II
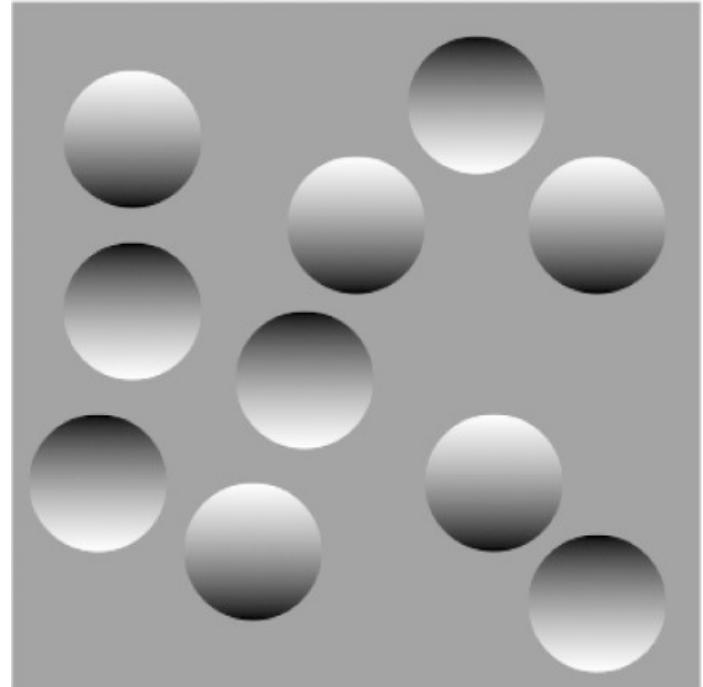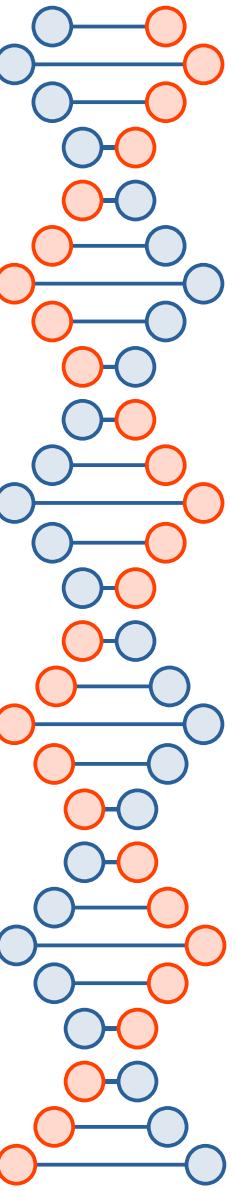
Shade objects illusion
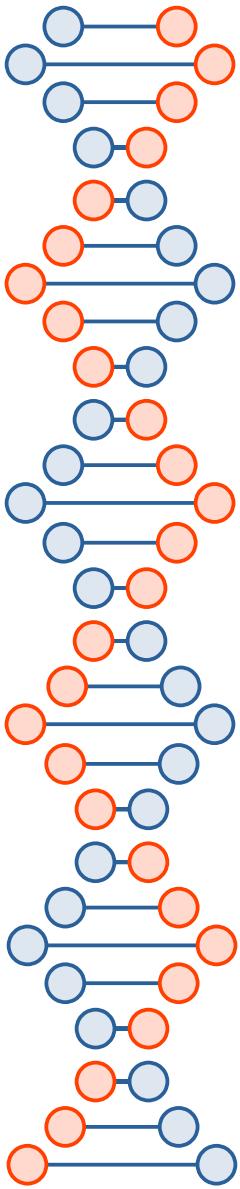
- Shaded objects
    - Visual system assumes that light source is from above
    - By altering the shading, the mind is fooled into perceiving different light sources, hence causing some of the objects to appear concave and others convex
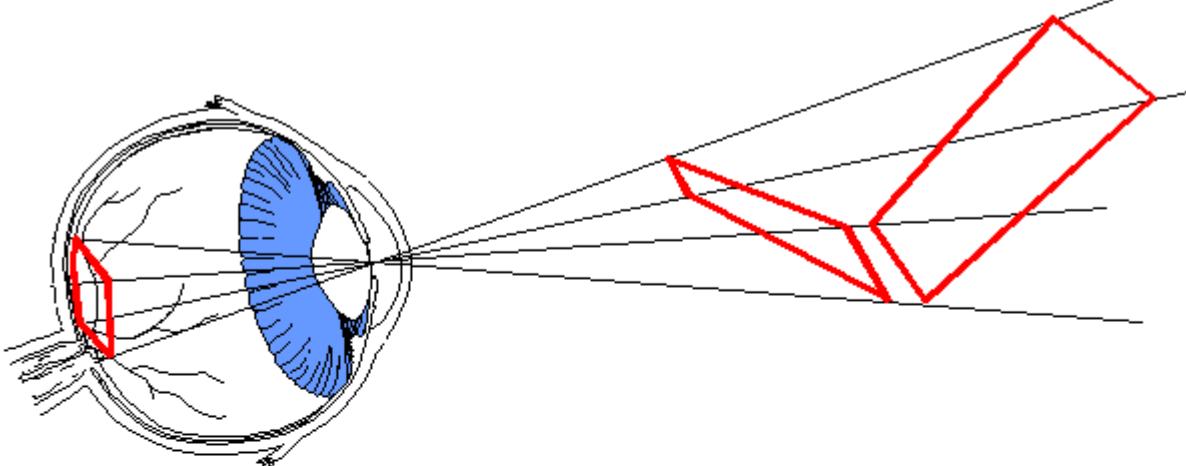
Introduction

- In spite of the flaws of our perceptual system when presented with ambiguous information, most times, the assumptions made are correct

- In general

  - Tasks that seem most natural and easy for people to handle are some of the most difficult to encode as intelligence in a computer system

Shape constancy example -
http://www.yorku.ca/eye/shape1.htm
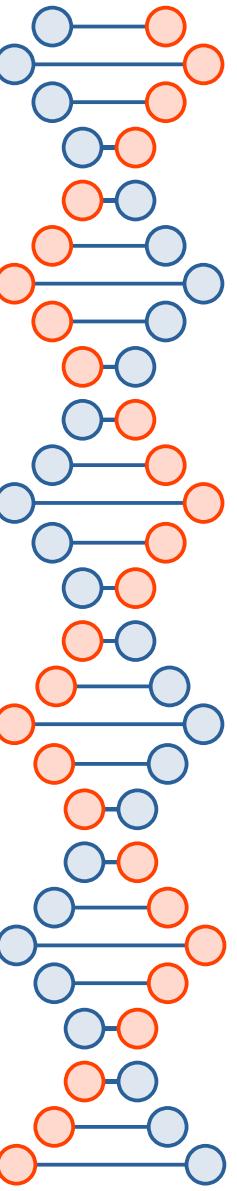
Because the two rectangles on the right subtend exactly the same visual angles, the images they project on to the retina are identical.
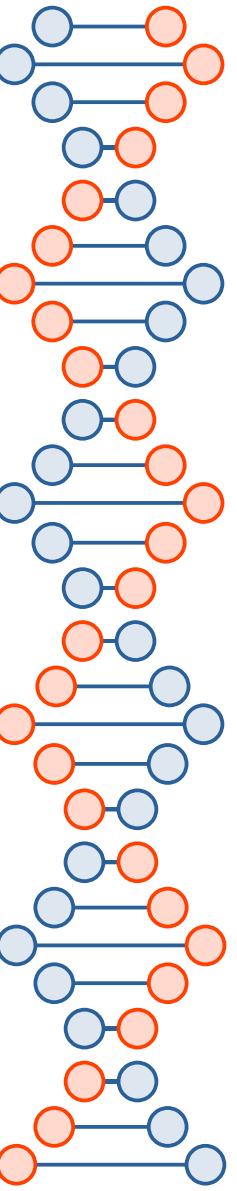
Nevertheless, one is able to observe the real shapes and slants of these objects. The technical jargon for this phenomenon is shape constancy.

More On Shape Constancy
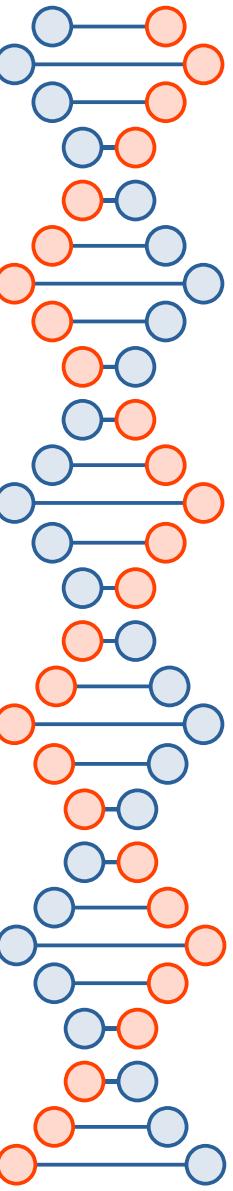
Possibilities

- Information overload
  - Life is full of possibilities
  - A lot of information is available to our cognitive system
  - But much of this information may be irrelevant to the task at hand
  - We need to be able to filter this information to concentrate on what is relevant
  - Challenge is that a lot of the available information is potentially useful – it is hard to single out what information is truly useful
  - In Chess for example
    - The number of ways in which the first ten moves can be played is in the order of billions
    - There are more possible sequences for the game than the number of atoms in the universe
    - Neither human nor machines can determine the best moves by considering all the possibilities, but clearly, machines can work out many, many more good moves than humans
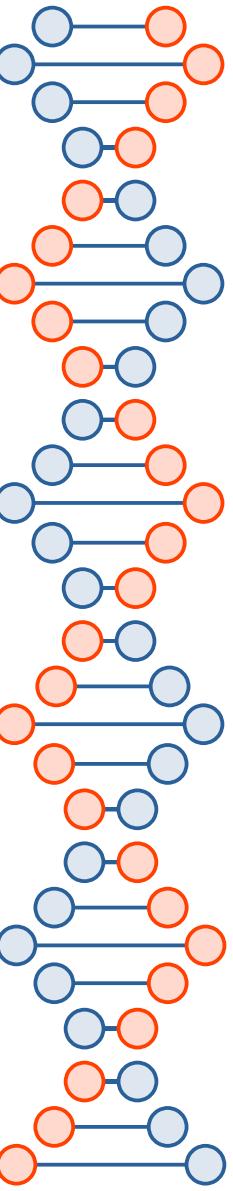
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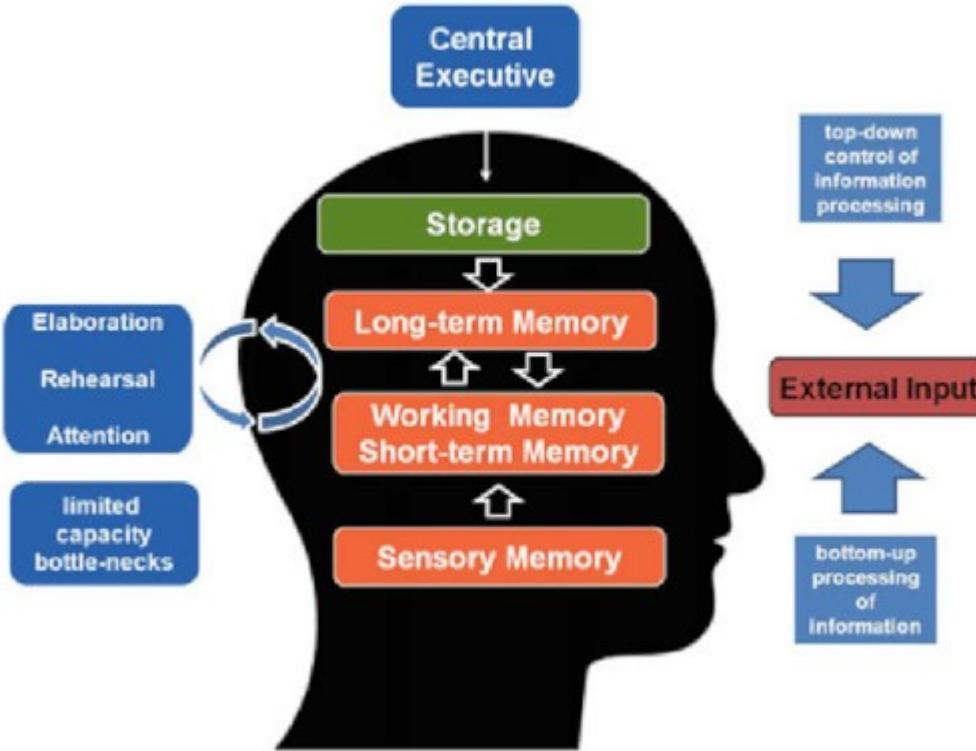
Framework for Cognitive Psychology
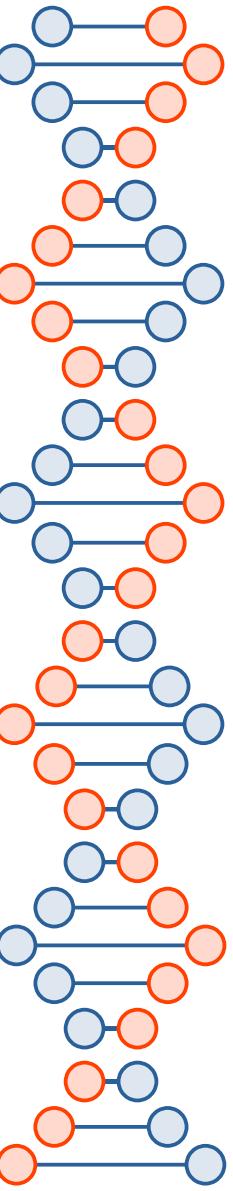
- Human information processing model
  - Has been very useful is cognitive psychology
  - Basic premise in this model
    - Views people as being like computers in the sense that we store, retrieve, and use information
    - A black box with inputs and corresponding outputs

Framework for Cognitive Psychology
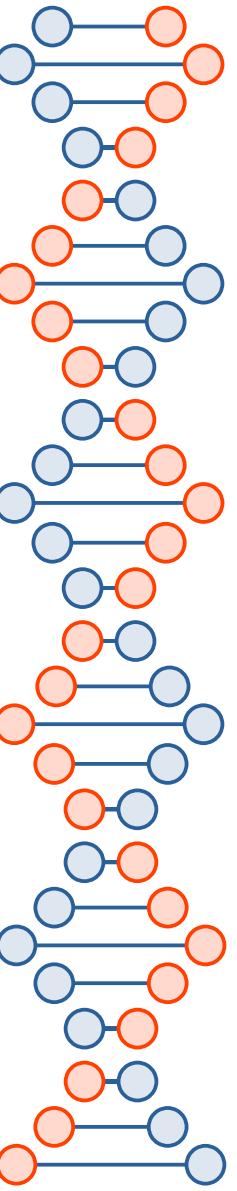
Cognitive Information Processing Model

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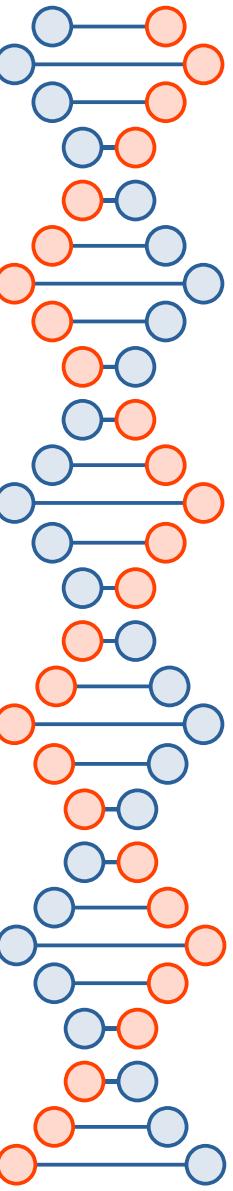
Framework for Cognitive Psychology

- Limitation of the Human information Processing Metaphor

  - Does not acknowledge the fact that humans are biological beings that have evolved such that our cognitive system is in the service of adaptive or functional behaviours

    - But humans are not general purpose computers, but rather, special purpose devices tuned to the demands of our environment
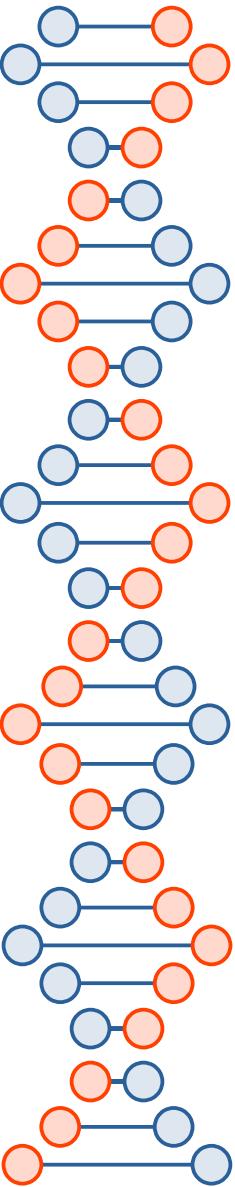
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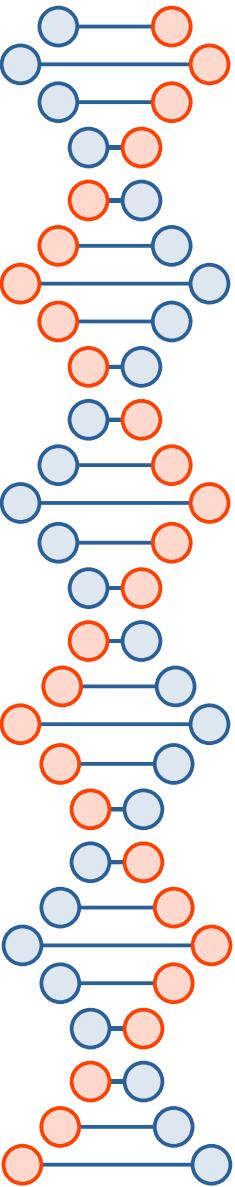
Some Issues – (1) Learning

- How does a child learn the word *rabbit*, and associate it to rabbits, when the parent points to a rabbit and calls out the word **rabbit**?
  - Does the child pay attention to the parent's finger or to the rabbit?
  - Even if the child is attending to the rabbit, how does she know that the word refers to the rabbit object, and not some property of the rabbit, e.g., its white colour or its fur, or to animals in general
  - This problem of under-representation is common, yet we know that somehow, learning does take place
- Humans (and organisms) appear to have certain biases and expectations that help them cope with these possibilities or ambiguities
  - How does a rat for example, work out the source of its illness?
    - The cat it saw during the day?
    - The noise of a bin?
    - Or the contaminated food it ate in the morning?
  - Laboratory research suggests that the rat would associate its illness to the taste and smell of the food it ate, and avoid these in future
- Many times, the biases are correct, other times, they are not
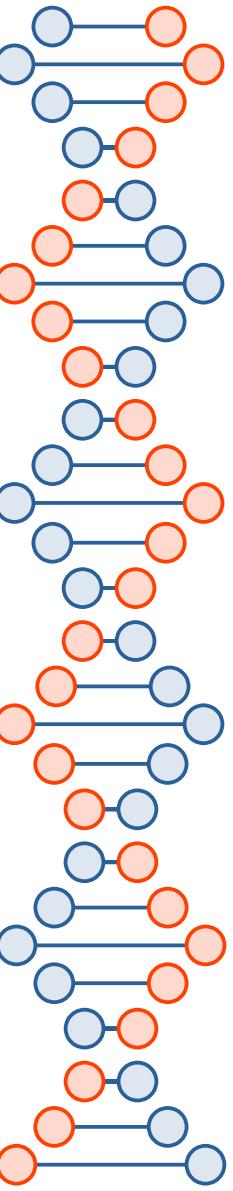
Some Issues – (2) Experience and Reasoning

- Understanding these is very challenging

- For example: John greets Mary warmly, and she replies in kind. Why is Mary friendly?

  - Because she is naturally friendly? Because of the nature of her occupation? Because John was friendly to her? Could she be pretending. Etc.

- Whilst psychologists can study these assumptions in a well designed experiment, people in general do not have sufficient information to choose between these competing explanations

- People must therefore adopt certain strategies that help them draw conclusions on other people's beliefs and behaviours
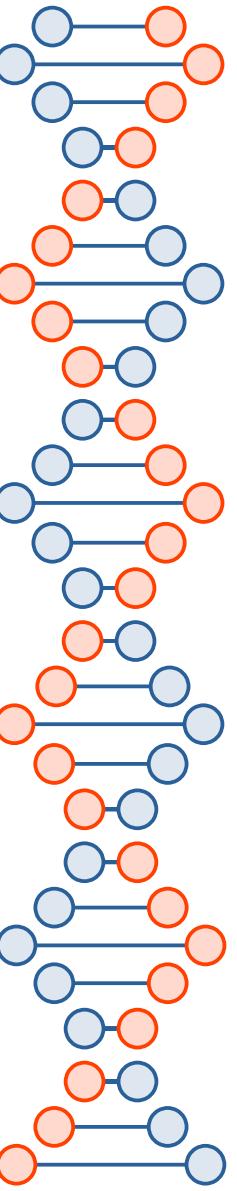
Some Issues – (2) Experience and Reasoning

- People must therefore adopt certain strategies that help them draw conclusions on other people's beliefs and behaviours
- One idea
  - People identify what is unusual in a situation and bias their causal attributions towards these abnormal conditions
    - We may (at least partly) attribute a car accident on a rainy evening to the unusual rainy conditions
    - But if the driver lives in a rainy area, we are less likely to attribute the accident to the wet conditions
- Without definitive information
  - Our attributions cannot be logically justified is almost all cases
  - Hence, experience might fail to provide relevant information and might even provide misinformation
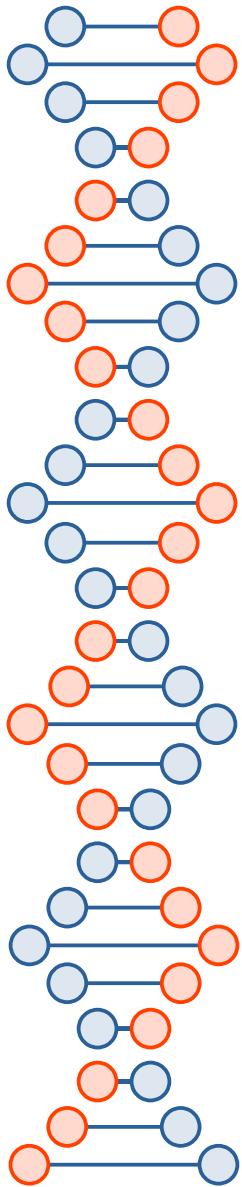
Some Issues – (3) Memory

- We normally do things by relying on past experience

- This involves accessing relevant memories

- Example, you encounter a snake whilst climbing rocks

  - The more relevant memories to access would be related to the danger of snakes, rather than memories like *snake* rhymes with *snowflake*, etc.

  - In this example, you need this information right away

    - But determining relevance is hard (too many potentially useful memories to access), and doing it quickly is even harder

    - A central theme in memory research is to discover how memory is organized to provide useful information when needed
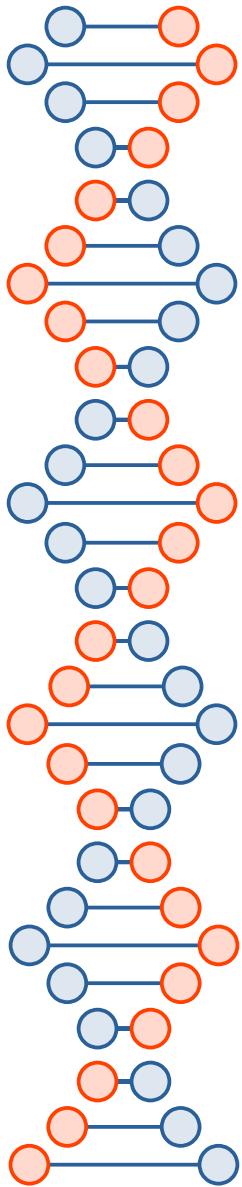
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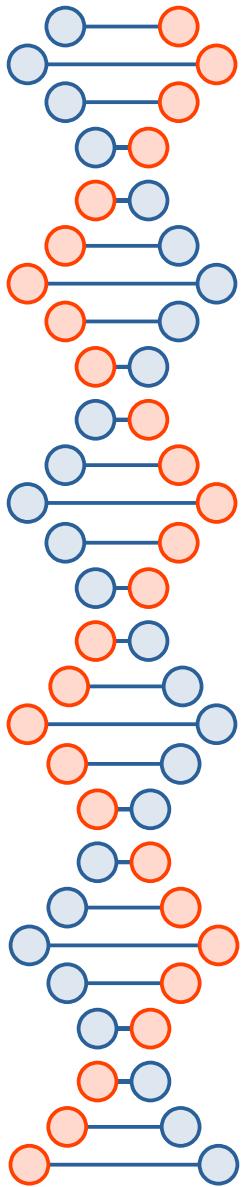
Experience and Experimentation

- How do researchers address the central question in cognitive psychology of understanding how the mind works
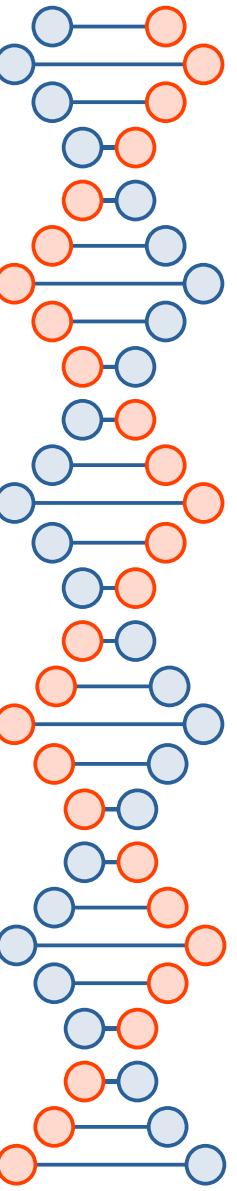
Experience and Experimentation

- Intuition and experience

  - Intuition

    - Idea: How plausible is it that something is true? If it sounds reasonable, it is probably true

    - Example

      - From intuition, we may agree that *the threat of punishment deters crime* because it seems reasonable that people would want to avoid punishment
      - And this can also be proven experimentally

    - Results from experiments usually make intuitive sense

    - Why cognitive psychology then, when a lot can be achieved by intuition?

      - Intuition is not infallible
      - Many times, our intuition about something is not correct
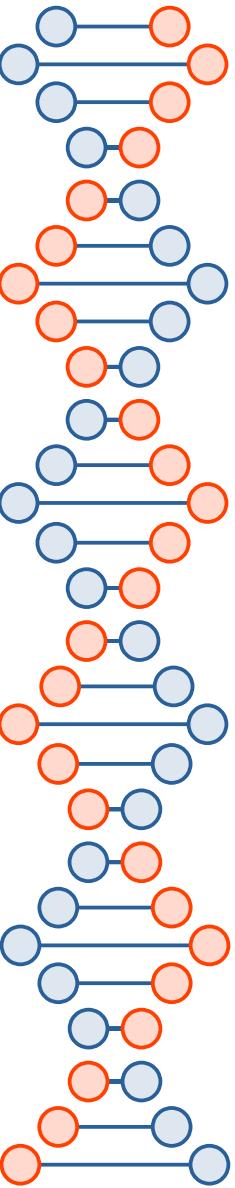
Experience and Experimentation

- Empiricism
    - The view that knowledge is derived directly from experience
    - Use observations and experimentation to determine truth
    - Cognitive psychology relies heavily on scientific observation and experimentation
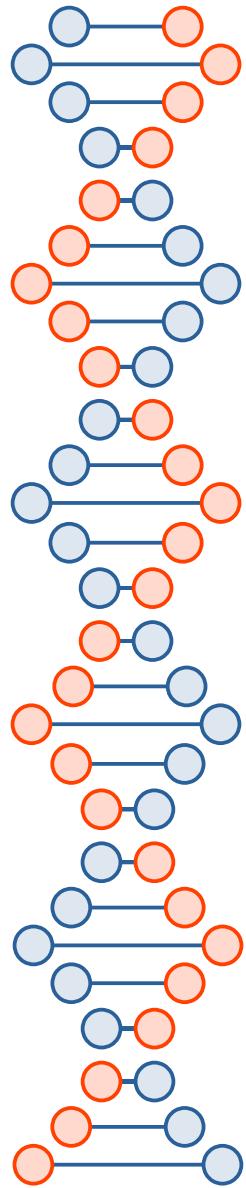
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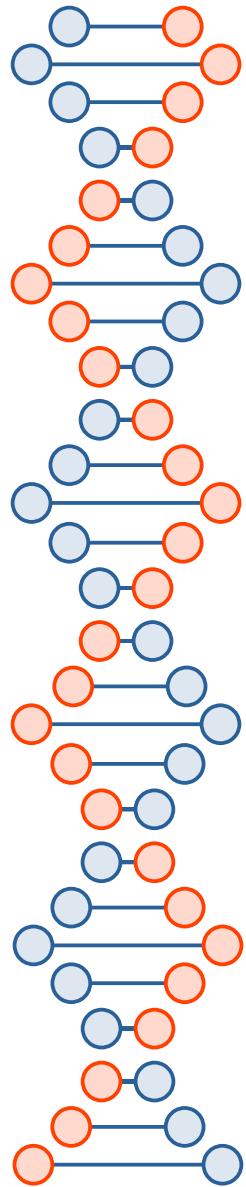
Roots of Cognitive Psychology

- Two categories of approaches have been used to study the mind

  - Philosophical approaches using introspection

    - These approaches are used in theory building in psychology

  - Biology, using observational (and empirical) methods to study the mind

    - Used in experimentation in psychology today
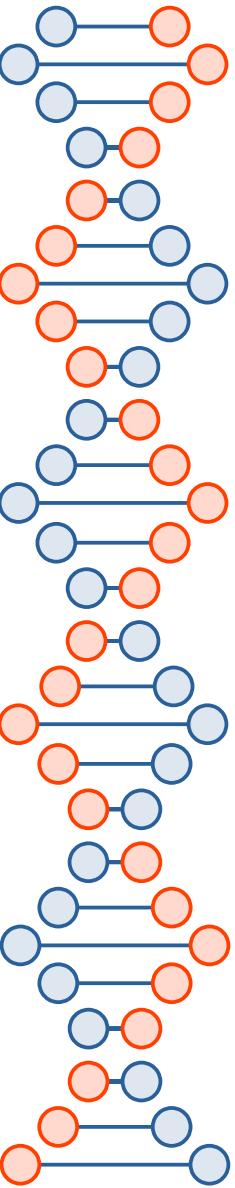
Roots of Cognitive Psychology

- Some early pioneers
  - Rene Descartes (1596- 1650)
    - Emphasized reflective methods (rationalism) like introspection over observation to study mind
  - John Locke (1632-1704)
    - Emphasized observation as a method (empiricism) to study mental processes
  - Immanuel Kant (1724-1804)
    - Eighteenth century German philosopher
    - Addressed the issue of rationalism and empiricism and concluded that both approaches must be used to decipher truth and about reality of mind
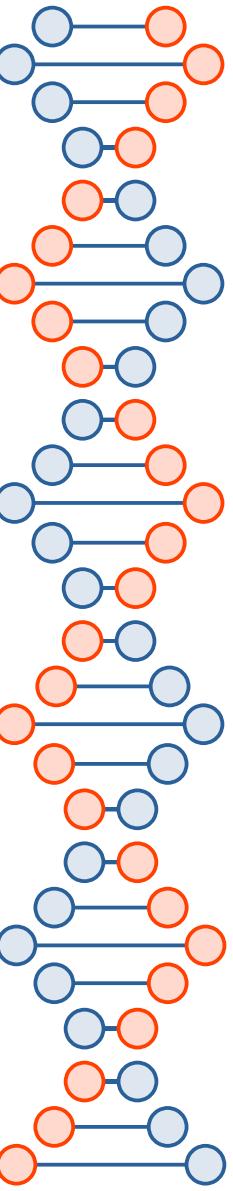
Roots of Cognitive Psychology

- Introspectionism (Wilhelm Wundt)
  - We earlier on saw examples of illusions to demonstrate limitations of intuition
  - Idea of introspectionism
    - Trained observers could overcome limitations of intuition by careful analysis
      - E.g., analysis similar to the ones that trained observers use to analyze shading techniques and cues to depth in paintings
  - Goal of instrospectionism was to understand the basic structure of consciousness (perception and thought)
    - The idea that just as physical things can be analyzed into their parts and elements, so too could thought be analyzed into its substructures and elements
- Problems with introspectionism
  - Perception and behaviour involves unconscious (not only conscious) inferences as suggested by introspectionism
  - Experiments on introspectionism did not seem to reveal the expected structure of thought
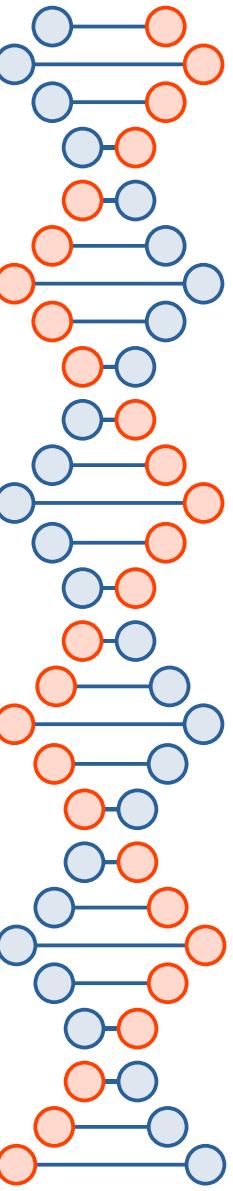
Roots of Cognitive Psychology

- Behaviourism

  - Considers psychology as a study of behaviour

  - Goal: prediction and control of behaviour

    - Unlike introspectionists that looked for building blocks of consciousness, behaviourism looked for building blocks of behaviour

  - Emphasized patterns of reinforcement and behaviours

    - Proposed that the basic unit of behaviour is the reflex, an automatic action by the body that occurs when a particular stimulus is perceived in the environment

  - Problem with behaviourism

    - Behaviourism completely ignored thought and consciousness

The Cognitive Approach

- Human behaviour can be explained as a set of scientific processes

- Our behaviour can be explained as a series of responses to external stimuli

- Behaviour is controlled by our own thought processes, as opposed to genetic factors

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The Cognitive Approach