The Cognitive Perspective

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Introduction to Psychology:
Theory & Practice

Overview

- The rise of cognitive psychology

- What is this 'thing' called cognition?

- Piaget's theory of cognitive development

- Mental representations and formal reasoning

- Evaluation of Piaget's theory

The rise of cognitive psychology

– '…is concerned with the internal processes involved in making sense of the environment, and deciding what action might be appropriate' (Eysenck & Keane, 2005, p. 1)

– MIT (1956) and the attack on the behaviourist movement:

– Noam Chomsky's theory of language vs. Skinner's 'Verbal Behaviour' (1957)

– George Miller's 'Magic number seven plus or minus two' and short-term memory

– Newell and Simon's General Problem Solver (discussed in Newell, Shaw, & Simon,1958)

What is this 'thing' we call cognition?

STIMULUS

↓

Attention

↓

Perception

↓

Thought Processes

↓

Decision

↓

RESPONSE OR ACTION
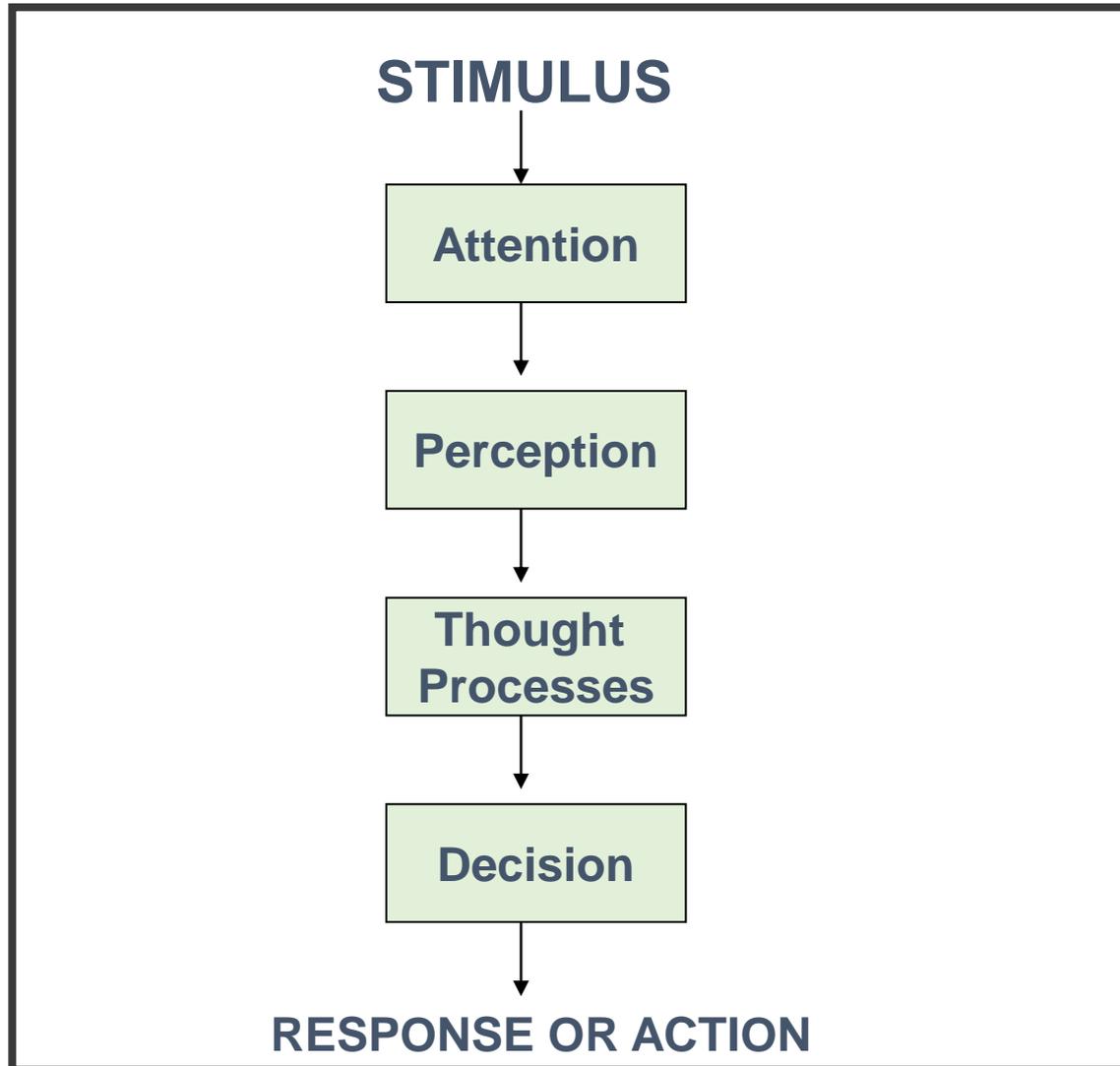
COGNITION IS WHAT OCCURS BETWEEN STIMULUS AND BEHAVIOUR

WE THINK!

Thinking and reasoning

- Do you think what I think you think? (Hedden & Zhang, 2002)

- First we will ask how does the ability to think and reason develop?

- We will look at children's reasoning today to find out

- The Swiss psychologist Jean Piaget

- Piaget's theory of cognitive development (1920s)

Piaget's thinking about thinking

- – In the 1920s Piaget was working on intelligence testing with Alfred Binet (who invented the first I.Q. test and children's I.Q. test)

- – But Piaget hypothesised that children's wrong answers may reveal insights into how their minds worked

- – Hence revealing insights into how reasoning develops in homo sapiens over time!

Piaget's theory

- The child is not a 'tabula rasa' (e.g., Locke)
- There is an interaction between the child's maturing abilities and their interactions with the environment
- Cognition is the **active** adaptation by the organism to the environment
- Children as 'little scientists' (e.g., "Mommy's face paint makes such pretty patterns on the nice carpet…")
- Children then construct 'theories' or 'schemas' of how the physical and social world's operate (e.g., if I push this plate off the table it falls down and I get Mommy's attention)

Assimilation

- Schemas are cognitive structures, that is, 'mental operators' that can be applied to objects, beliefs, ideas etc. (e.g., if I clean my room, then I will get pocket money...)

- Children make constant mental adaptations to new observations gained from experiments...

- When a child encounters a novel object or event, they try to understand it in the context of their existing knowledge and beliefs about the world (e.g., 'car' schema).

- Piaget termed this process **assimilation**

Accommodation

– But what if the child sees a train and says 'car'?

– His parents will correct them and say 'train' and now the child may develop a new schema to accommodate 'trains'

– Piaget termed this process **<u>accommodation</u>**

Piaget's stage theory of cognitive development

– Development occurs in stages of increasing complexity of cognition

– **Four stages**

– Stage 1: The sensorimotor stage   (birth – 2yrs)

– Stage 2: The preoperational stage   (2-7yrs)

– Stage 3: The concrete operational stage   (7-11yrs)

– Stage 4: The formal operations stage   (11yrs onwards)

Stage 1: The sensorimotor stage (birth- 2yrs)

- Discovery through sensory inputs such as sucking, grasping, orientation to sound and eye movements (e.g., what happens when they push their plate over the edge of the table...

- The concept of self as separate from the world emerges

- **For example, Object Permanence   (e.g., Peek-a-boo!)**

  - The awareness that an object continues to exist even when it is not present to the senses

  - Out of sight, out of mind

  - A ball hidden behind a screen | Baby sights ball beforehand

  - The screen is pushed and it does not land flat on the floor and baby is surprised or not surprised...
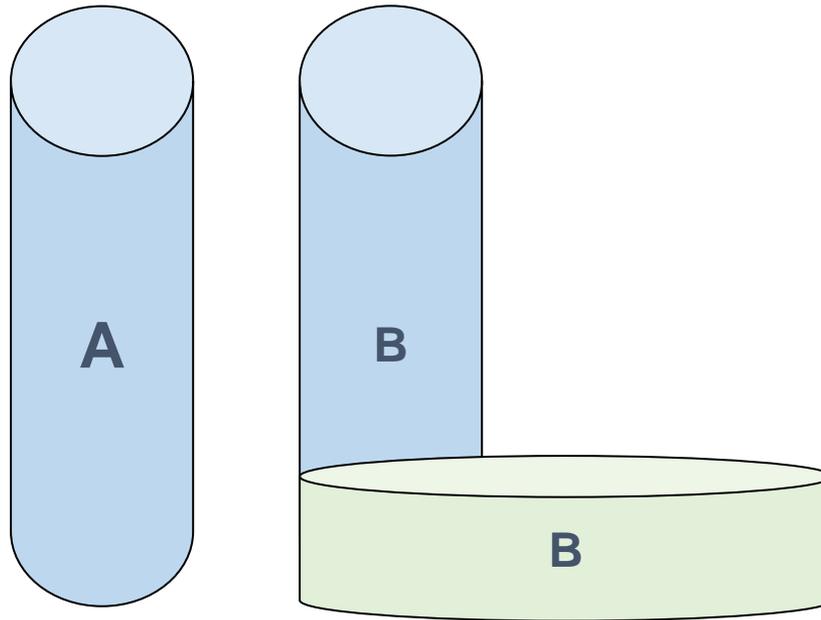
Object permanence
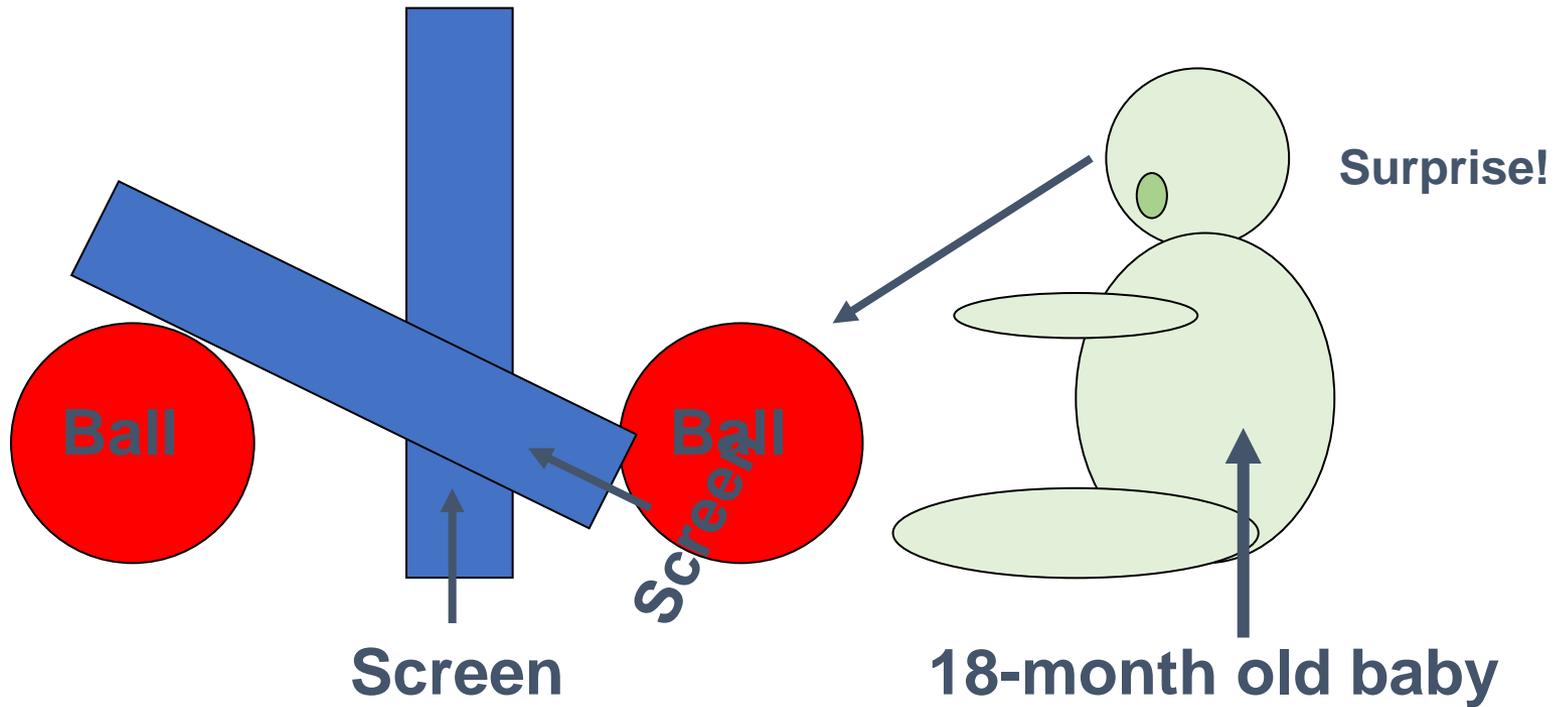
Ball

Ball

Screen

Screen

Surprise!

18-month old baby

Stage 2: The preoperational stage (2-7yrs)
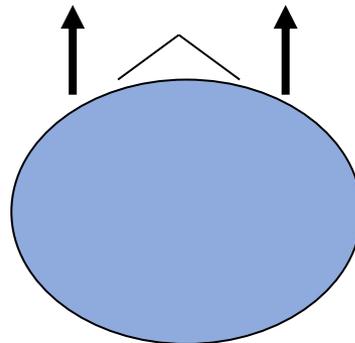
– The child does not yet comprehend certain rules or operations, for example physical laws in the world.

– **Experiment in Conservation**

  – The understanding that any quantity remains the same despite physical changes in the arrangements of objects

  – Experimenter shows the child two long thin beakers with equal amounts of liquid

  – Child understands liquid volume equivalence

  – Pours one amount into a short broad container

  – Asks which now has the most liquid...

  – But the child in the preoperational stage

Law of conservation

The liquid from the tall thin Container B is poured into the short broad container B

Q: Which container holds more liquid?
A: 'The taller one' (examine this response)

Stage 2: The preoperational stage (2-7yrs)

- The child does not yet comprehend certain rules or operations, for example physical laws in the world.

How does Piaget explain the Conservation Study results?

- The pre-operational child's thinking is determined by the perceptual nature of objects;

- Pre-operational children's thinking is not governed by the principles of **reversibility** (you can pour the liquid back into the tall thin container)

- Or **compensation**, where the decrease in height is compensated by an increase in breadth

- Or **identity**, where no amount of liquid has been added or taken away

Egocentrism, (e.g., Piaget and Inhelder's 3 mountain exp, children matched the pictures of different views of the three mountains to what they could see, not what the doll could see.

Stage 3: The concrete operational stage (7-11yrs)

– Children become able to deal with mental operations that fit a logical system (e.g., the child can make conclusions that take the law of conservation into account)

– But the use of mental operations at this stage is not concrete

Exp Transitivity Tasks

"Mei is taller than Jane, and Jane is taller than Michelle"... "Is Mei or Michelle taller?"

– Children cannot do this task in their heads, but they can do it when they have external objects such as dolls, or when they know the people we are talking about...

Stage 4: Formal Operations (11yrs onwards)

- Children can reason mentally without the use of external objects to solve reasoning tasks

- Children can reason from verbally stated hypotheses to draw conclusions about the truth of logical premises

- They can deduce conclusions from abstract content

- If "A is taller than B, and B is taller then C", then "A is taller than C".

Evaluation of Piaget's theory

This theory had an enormous impact in developmental, educational and general psychology but:

+ Piaget emphasised that children were ACTIVE assimilators of new knowledge rather than passive receivers as traditional behaviourism would have led us to believe...

+ Piaget emphasised that children constructed new knowledge from previous knowledge, structures which has held true for studies of expertise acquisition (e.g., Chase & Simon, 1973)

+Piaget emphasised that new reasoning abilities such as deduction depended on the mergence of previous ones such as success on transitivity tasks (or syllogisms)

- As with any stage theory, Piaget's theory is not flexible enough to account for children who may skip from the preoperational to formal stage, or go back a stage in development.

- Also, the stage theory is put forward as a universal theory of cognitive development, and different children may reach different stages at different ages depending on their abilities and education...

- Piaget's theory did not account for the child's cognitive development as a process that occurs in a socio-cultural context (e.g., Vygotsky, 1973), for example learning a highly formally skilled task from a parent at a preoperational age.

- Not all adults and adolescents actually develop abilities associated with the formal operations stage.

Mental representations and formal reasoning

- It is important to note that Piaget's theory was developed in line with theories that assumed people had an internal 'mental logic' for reasoning with formal logical relations such as those in transitivity tasks (e.g., Rips, 1979: Braine, 1978)

- Nowadays it is generally accepted that people reason by constructing mental representations called Mental Models (Johnson-Laird, 1983), be they logic or probabilistic-based.

- We will talk more about theories of adult reasoning tomorrow, but for now take this point in as a contemporary criticism of the foundations of Piaget's theory of cognitive development.

- Piaget's theory does not account for internal mental representations that children may be able to construct for themselves.

The Cognitive Perspective

An Evaluation:
Adult Thinking and Reasoning

Overview

- Are adult thinkers rational?

- Conscious and unconscious thought

- Reasoning and rationality

- Problem solving

- Creativity and imagination

Are adult thinkers rational?

Introduce to class: Wason's Rule Discovery Task (Wason, 1960)...

– Lets see how good we are at reasoning

– Think of a numerical rule that the number sequence 2-4-6 conforms to...

– Now generate your own sequences with sets of three numbers

– Call them out....

– The rule is actually 'ascending numbers'...

Confirmation bias (Wason, 1960)

" likely explanation for the perpetuation of myths is the fact that stereotypes are such powerful things"

"An ancient truth is worth restating here: if a generalisation about a group of people is believed, whenever a member of the group behaves in the expected way, the observer notes it and his belief is confirmed and strengthened…"

when a member of the group behaves in a way that is not consistent with the observer's expectations, the instance is likely to pass unnoticed…' (Maccoby & Jacklin, 1974; p.365)

The role of falsification in hypothesis testing

– To overcome untrue hypotheses (Popper, 1959)

Introduce Popper's Black Swan example...

– People find falsification impossible (Poletiek, 1996; 2001)
– People find falsification of their own hypotheses possible when they have a large repository of domain expertise (Cowley & Byrne, 2004; Cowley, 2017);
– When they test someone else's hypothesis (Cowley & Byrne, 2005; Cowley, 2017);
– And find negative testing of their own hypothesis possible, but implausible, when they compete with an opponent hypothesis tester (Cowley, 2017)

Stereotypes and irrationality

– consider the example provided by **Anne Frank** in her famous diary:

"…Jews are regarded as lesser beings. Oh, it's sad, very sad that the old adage has been confirmed for the umpteenth time: 'What one Christian does is his own responsibility, what one Jew does reflects on all Jews'." (22nd May, 1944, p. 302)

– Anne Frank logically proves that this belief is false. One falsifying case can prove that this prejudiced belief is false.

– The standard version of the 2-4-6 task, when the participant's hypothesis is embedded within the true rule, is analogically equivalent to this prejudiced belief (Wason, 1960).

Heuristics and biases

– A **heuristic** is a quick process by which a rule of thumb is applied to a situation in order to reach a conclusion

– **Availability heuristic** (Tversky, Slovic and Kahneman, 1982): the probability is judged by the ease with which familiar instances can be brought to mind (e.g., stereotyping)

– **Representative heuristic** (Tversky, Slovic and Kahneman, 1982): the degree to which something is representative of something else (e.g., Josh the librarian)

– **Hindsight bias** (Sanna *et al.,* 1999): the tendency to overestimate one's ability to have predicted an event once the outcome is known 'I knew it all along…'

Contemporary theories of deductive reasoning

- Dual-system theories (e.g., Evans, 2003)
    - Implicit (Unconscious) and
    - Explicit (Conscious) processes
    - Working memory constraints (e.g., Baddeley, 1986; 1997)

- Mental Models (e.g., Johnson-Laird, 1999)
    - The principle of truth
    - Alternatives and counterexample search
    - Working memory constraints (e.g., Baddeley, 1986; 1997)

The structure and nature of these processes are nowadays argued to be probabilistic rather than rigid and constrained by any logical framework one way or another…

(*Chater, N. and Felin, T. and Funder, D.C. and Gigerenzer, G. and Koenderink, J.J. and Krueger, J.I. and Noble, D. and Nordli, S.A. and Oaksford, Michael and Schwartz, B. and Stanovich, K.E. and Todd, P.M. (2018) Mind, rationality, and cognition: an interdisciplinary debate. *Psychonomic Bulletin & Review* 25 (2), pp. 793-826.)

Unconscious and conscious thought

- **Unconscious thought** refers to thinking that we are not aware of; it is implicit and non deliberate and may be carried out without much effort…

- Unconscious thought is often referred to as ***subconscious processing*** which allows us to perform more than one task simultaneously (e.g., driving a car)

- **Conscious thought** refers to thinking that we are aware of; it is explicit and deliberate and carried out in a concerted effort and includes:

  - Problem solving

  - Deductive reasoning and Inductive reasoning

  - Hypothetical thinking

  - Creative and imaginative thought
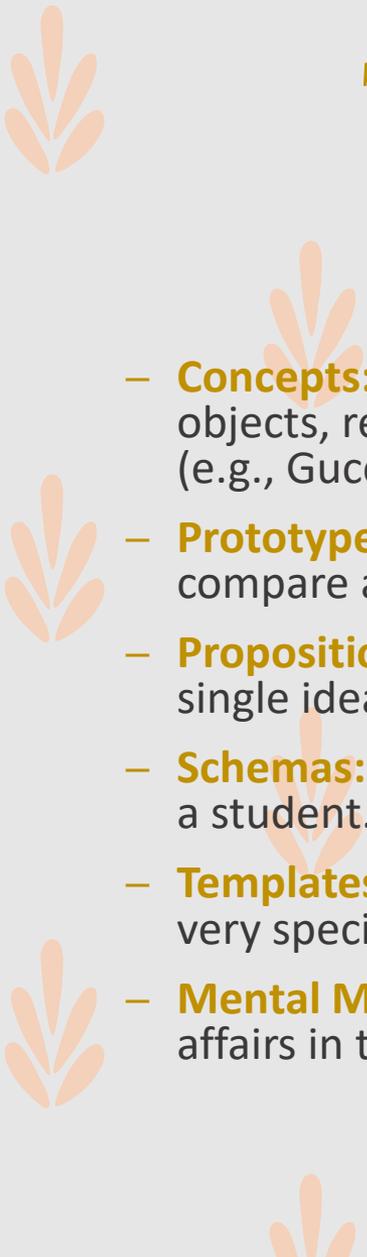
The building blocks of thought: 'Mental Representations'

- **Concepts:** are the building blocks of thought; a mental category that groups objects, relations, activities and abstractions and can be hierarchically structured (e.g., Gucci; Dolci & Gabana and Prada are designer brands)

- **Prototypes:** an especially representative example of a concept by which to compare a new object for categorisation (e.g., Labrador vs. Shiatsu)

- **Propositions:** units of meaning that are made up of many concepts and express a single idea (e.g., dogs are clever)

- **Schemas:** a complex representation of all we know about a concept such as being a student...

- **Templates:** a set of abstract schemas that is a general representation rather than very specific (e.g., what a researcher knows about how to write a research report)

- **Mental Model:** each model represents a possibility, that is, a possible state-of-affairs in the world.

Deductive reasoning

- **Deduction:** reasoning from the general to the specific (Manktelow, 1999; 2012)

  - Premise: If there is maple syrup, then Michelle will eat the pancakes

  - Premise: There is no maple syrup

  - Conclusion: What can you conclude? Michelle will not eat the pancakes

  - Modus Tollens (Propositional logic)

- **Problem:** two premises can be true yet conclusion can be false (e.g. all Professors are rich, Jim is a Professor, therefore Jim is rich, but gambling problem...)
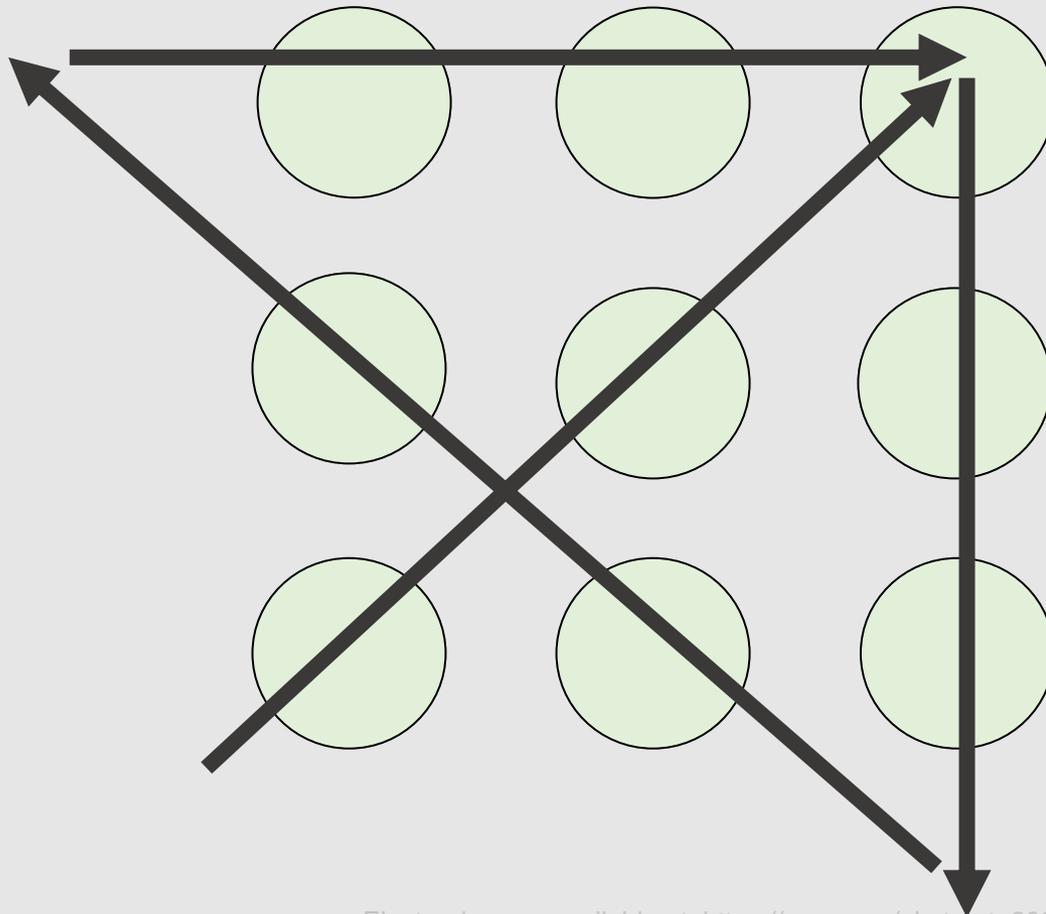
Inductive reasoning

– **Induction:** Reasoning from the specific to the general

– Michelle loves pancakes, I bet she loves pastries….

– **Problem:** Often we must go beyond the information given, but we cannot prove it is ever true…

– Michelle doesn't like pastries…

(e.g., falsification and the prejudiced stereotyping example earlier)

Problem Solving

Example: Nine-dot problem

Insight problem solving.
The solution may often
just 'pop' into one's head
(unconscious processing)

Or:
1) Elaboration
2) Constraint relaxation
3) Re-encoding or
 re-categorisation
(Ohlsson, 1992)

Problem Space Theory
(Newell & Simon, 1972)

– Requires search through a problem space of alternative possible moves (e.g., conscious processing)

  – Tower of Hanoi (Anzai & Simon, 1979)

  – Chess (Newell & Simon, 1972)

  – Physics (Chi, Glaser, & Rees, 1981)

– A number of operators (e.g., the bishop moves diagonally)

– Sub-goals and ultimate goals (e.g., to win an opponent piece or to checkmate)

– Choice of move is related largely to previous experience and expertise (e.g., Chase & Simon, 1973; Gobet, 1998)

Creativity and imagination: Structured or unstructured?

Experiment: Participants were given a blank piece of paper on which they were to draw imaginary animals. They were first asked to imagine going to another planet somewhere else in the galaxy that was very different from earth, to imagine finding an animal there, and to draw a front and side view of the animal…another same species… different species… etc

What they tended to draw: Animals with bilateral symmetry, appendages, sense organs… etc
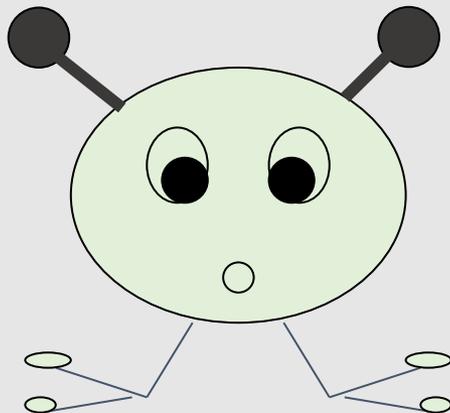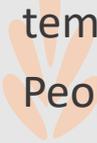
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Exemplar Generation. *Cognitive Psychology, 27*, 1-40

Evaluation of adult thinking and reasoning

– People may be rational in principle but err in practice (Johnson-Laird, 1999)

– People may have two systems for reasoning: an implicit system for quick heuristics and may be prone to biased conclusions, and a slower explicit system for working out the details in order to come to conclusions (e.g., Evans, 1989)

– The building blocks of thinking are economic structures (they do not preserve exact images or details rather they comprise of general concept, schemas and templates…

– People tend to rely on old prototypes to create new ones…

– People are rational when they have mastered a large repository of domain specific knowledge…

– Are people rational or irrational more generally? Or are they economic (e.g., Simon, 1957; Gigerenzer, 1999)

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