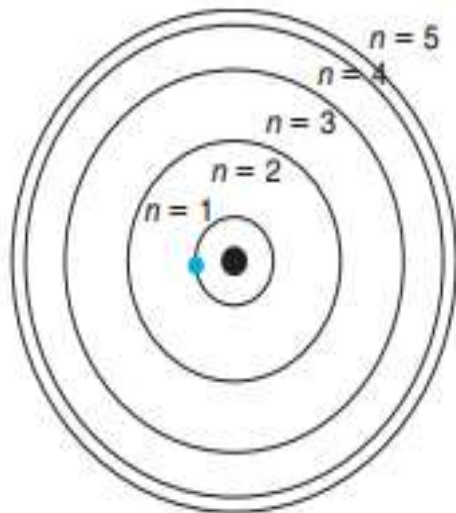


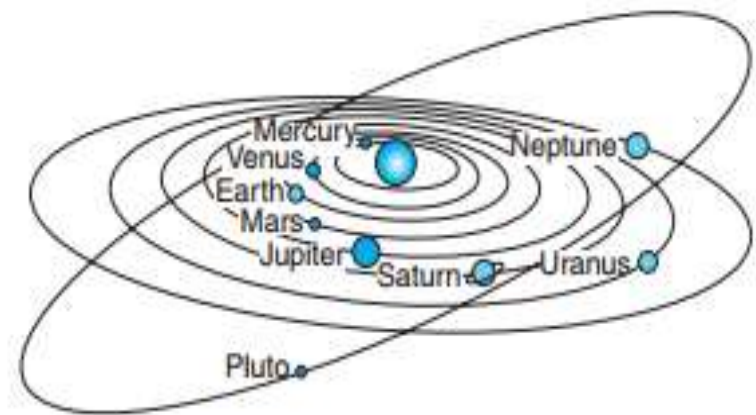


Reasoning and Logical Thinking

Analogical Thinking



Bohr Model of the Hydrogen Atom



The Solar System



Basic Definitions

- **Deductive thinking**

- Reasoning from a general to specific base
- Uses facts and rules

- **Inductive thinking**

- Reasoning from a specific to general base
- Uses conjecture

Deductive

Generalization (or Rule) -----> Specific Example

Inductive

Specific Example -----> Generalization (or Rule)

Deductive Thinking

- (i) All humans are mortal;
- (ii) I am a human;

The conclusion;

- (iii) Therefore, I am mortal.



Inductive Thinking

(i) All swans that have been observed are white;

The conclusion;

(ii) All swans are white.



Inductive Thinking

(i) I have been fed every day up to this day (November 23rd)

The conclusion;

(ii) Therefore, I will be fed tomorrow (November 24th - Thanksgiving).





Logical Thinking

■ Belief Bias Effect

- Top-down knowledge and schemas are useful...but can encourage us to make mistakes
- Judgments are made based on prior beliefs and general knowledge, rather than on the rules of logic
- Errors made when the logic of a reasoning problem conflicts with individual's background



Logical Thinking

■ Wason Selection Task

- Subjects shown four cards with a letter on one side, and a number on the other
- One conditional claim: Every card with “D” on one side has a “3” on other side
- Subjects then asked which cards to turn over to determine whether the conditional claim is true

Wason Selection Task

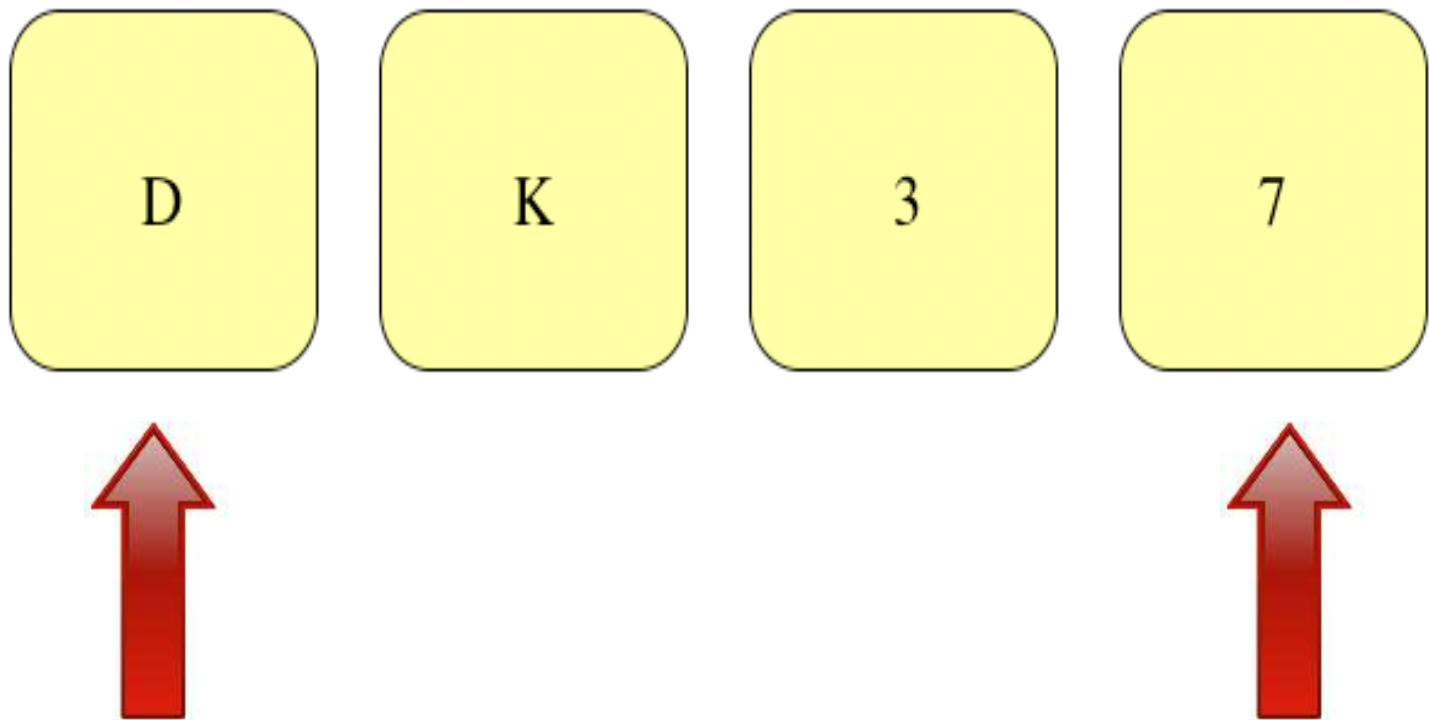
D

K

3

7

Wason Selection Task





Logical Thinking

■ Wason Selection Task

- Subjects typically perform very poorly
- Only about 10% correctly identify correct answer ('D' and '7')
- Performance improves on variations of the task



Logical Thinking

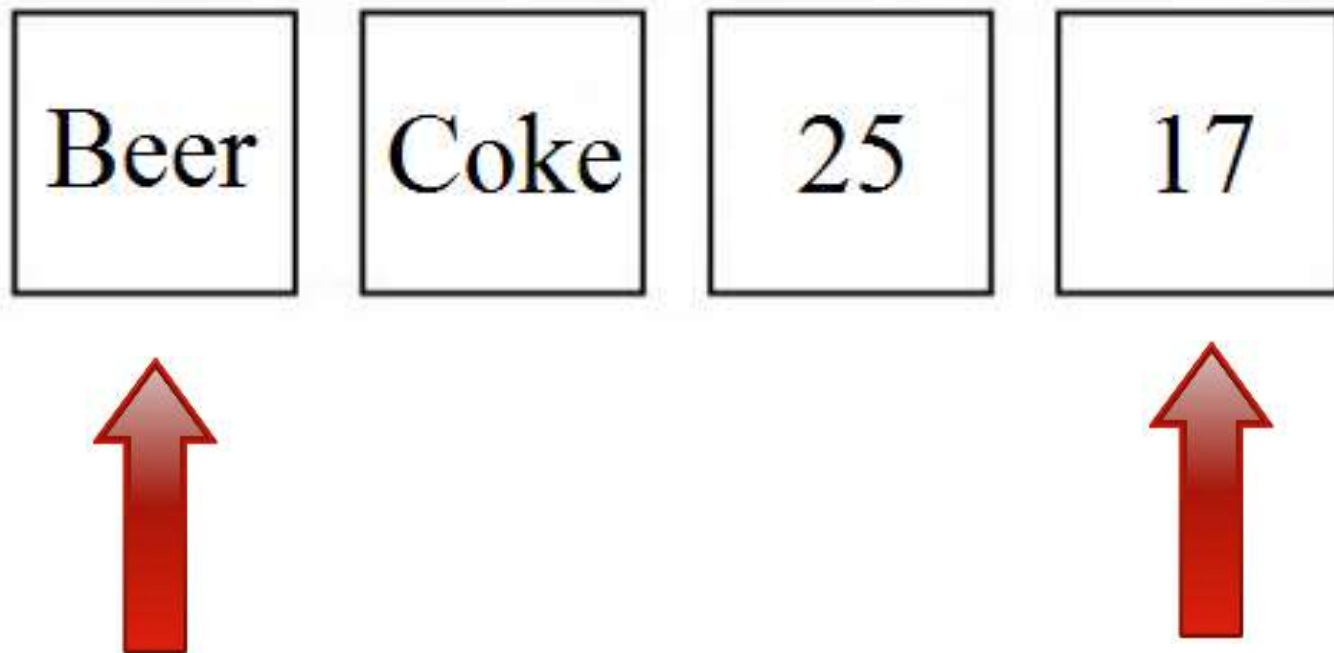
■ Wason Selection Task

- Subjects are told to imagine they are police officers observing people in a bar
- Four cards are shown that represents people at a table - age on one side, person's beverage on other
- One conditional claim: If a person is drinking beer, then s/he must be over 21 years of age

Wason Selection Task

Beer	Coke	25	17
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Wason Selection Task





Logical Thinking

■ Wason Selection Task

- Most subjects (74%) correctly select “drinking a beer” and “17 years of age” cards
- Minor changes in wording can have a significant cognitive impact
- Subjects perform better on selection tasks involving “realistic” vs. abstract contents

Activity

The Fortress problem

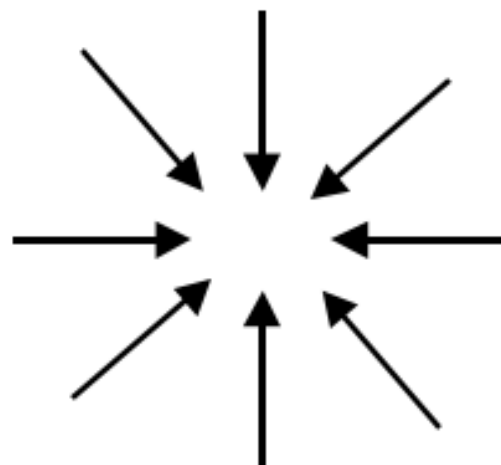
A small country fell under the iron rule of a dictator. The dictator ruled the country from a strong fortress. The fortress was situated in the middle of the country, surrounded by farms and villages. Many roads radiated outward from the fortress like spokes on a wheel. A great general arose who raised a large army at the border and vowed to capture the fortress and free the country of the dictator. The general knew that if his entire army could attack the fortress at once it could be captured. His troops were poised at the head of one of the roads leading to the fortress, ready to attack. However, a spy brought the general a disturbing report. The ruthless dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to be able to move troops and workers to and from the fortress. However, any large force would detonate the mines. Not only would this blow up the road and render it impassable, but the dictator would then destroy many villages in retaliation. A full-scale direct attack on the fortress therefore appeared impossible.

How did the general succeed in capturing the fortress?

Plan A



Plan B



Radiation problem

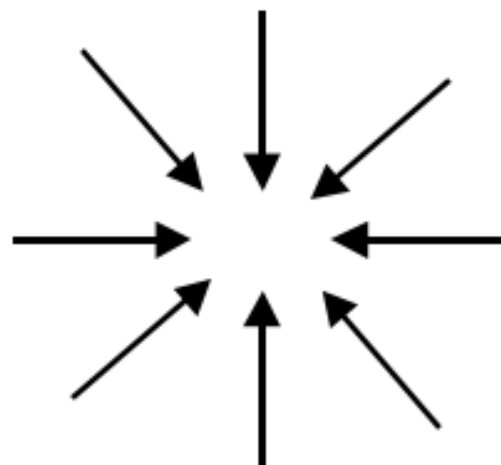
Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately at this intensity the healthy tissue that the rays pass through will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either.

What type of procedure might be used to destroy the tumor with the rays, and at the same time avoid destroying the healthy tissue?

Plan A



Plan B





Logical Thinking

- Two main rival psychological theories

(1) **Mental Logic Theory**

- Use of mental representations that resemble sentences of natural language
- In deductive reasoning, we manipulate these representations by applying syntactic rules of inference that resemble the rules of logic



Logical Thinking

- Two main rival psychological theories

(2) **Mental Models Theory**

- Deductive reasoning involves diagrammatic rather than language-like representations
- In deductive reasoning, we construct models that represent the possible states of world compatible with premise



Logical Thinking

- **Dual-coding hypothesis (Paivio)**

- Information mentally represented as a verbal or non-verbal system...or both
- *Picture-like code and word-like code*
- Each concept connected to other related concepts (activation of one primes activation of others)

