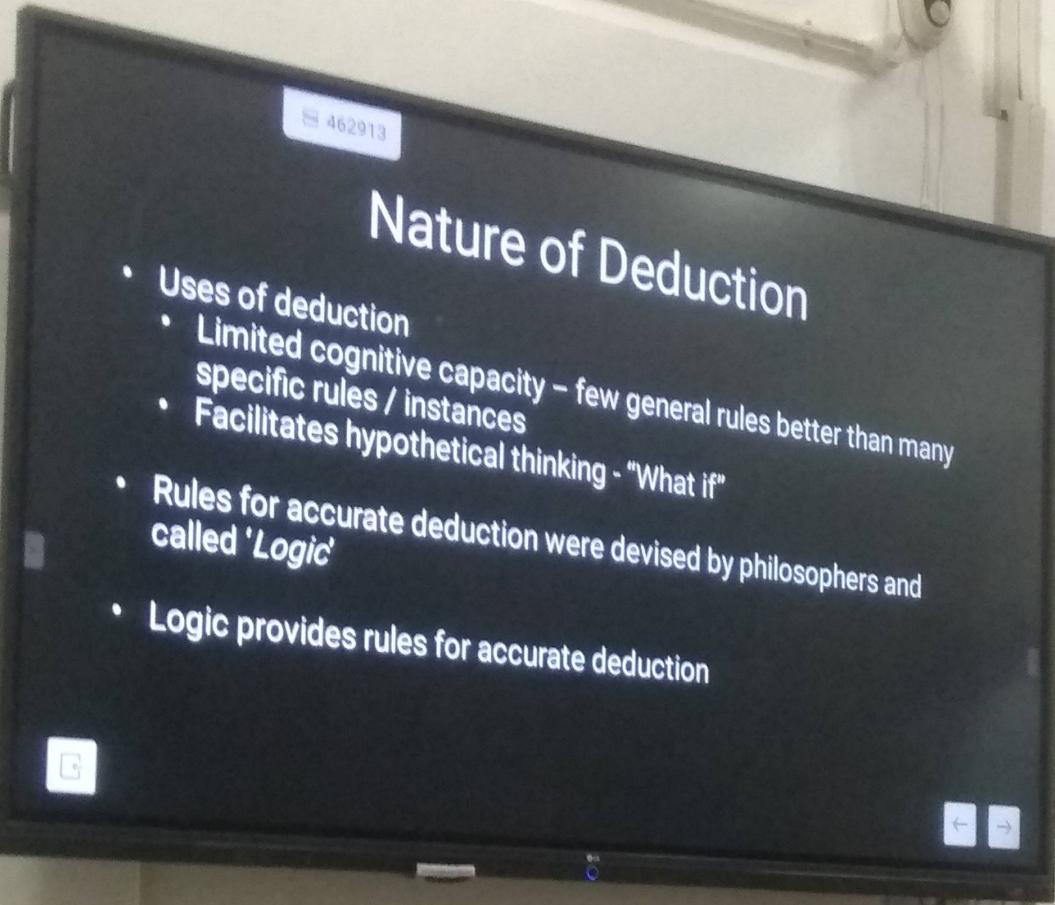


S1

SILENCE PLEASE

Nature of Deduction

- Uses of deduction
 - Limited cognitive capacity – few general rules better than many specific rules / instances
 - Facilitates hypothetical thinking - "What if"
- Rules for accurate deduction were devised by philosophers and called 'Logic'
- Logic provides rules for accurate deduction



168001

Nature of Deduction

- **Uses of deduction**
 - Limited cognitive capacity – few general rules better than many specific rules / instances
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- Rules for accurate deduction were devised by philosophers and called '*Logic*'
- Logic provides rules for accurate deduction

SILENCE P

Criteria for a Good Argument

- TERMS must be clear and unambiguous
- PROPOSITIONS/PREMISES must be true
- ARGUMENT must be logically valid (i.e. conclusion must follow from premises)

SILENCE

- Logic forms the basis of rational thought – Philosophical tradition
- Psychologists developed the ‘Deduction Paradigm’ to study thinking process:
 - Use people who are not trained in logic
 - Assume that premises of an argument are true
 - Check if the conclusion follows from the premise
- Main methods used in Deduction paradigm:
 - *Syllogistic Reasoning*
 - *Conditional Inference*
 - *Wason Selection Task*

SILENCE

495681

Syllogistic Reasoning

Table 7.1: The structure of classical syllogisms.

(a) Mood of premises

- A All A are B
- E No A are B
- I Some A are B
- O Some A are not B

(b) Figure of syllogism

1	2	3	4
A - B	A - B	B - A	B - A
B - C	C - B	B - C	C - B
—	—	—	—
A - C	A - C	A - C	A - C

Note: The letters A, E, I and O are classically used as abbreviations for the four moods of the premises.



Findings

- Fallacy – argument whose conclusion need not be true given the premise
- Many fallacies are endorsed – not random – systematic biases
- Consider the following:

All A are B

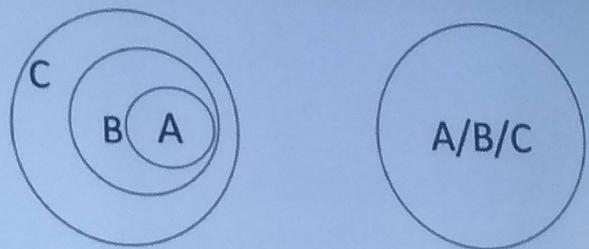
All B are C

Therefore, All C are A

397377



036929



A/B/C

77% of participants chose the invalid conclusion



036929

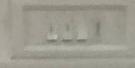
- Atmosphere Effect
 - disposition to accept conclusions whose mood matches that of the premise
- Consider the following example:

All A are B

All B are C

Therefore, Some C are A

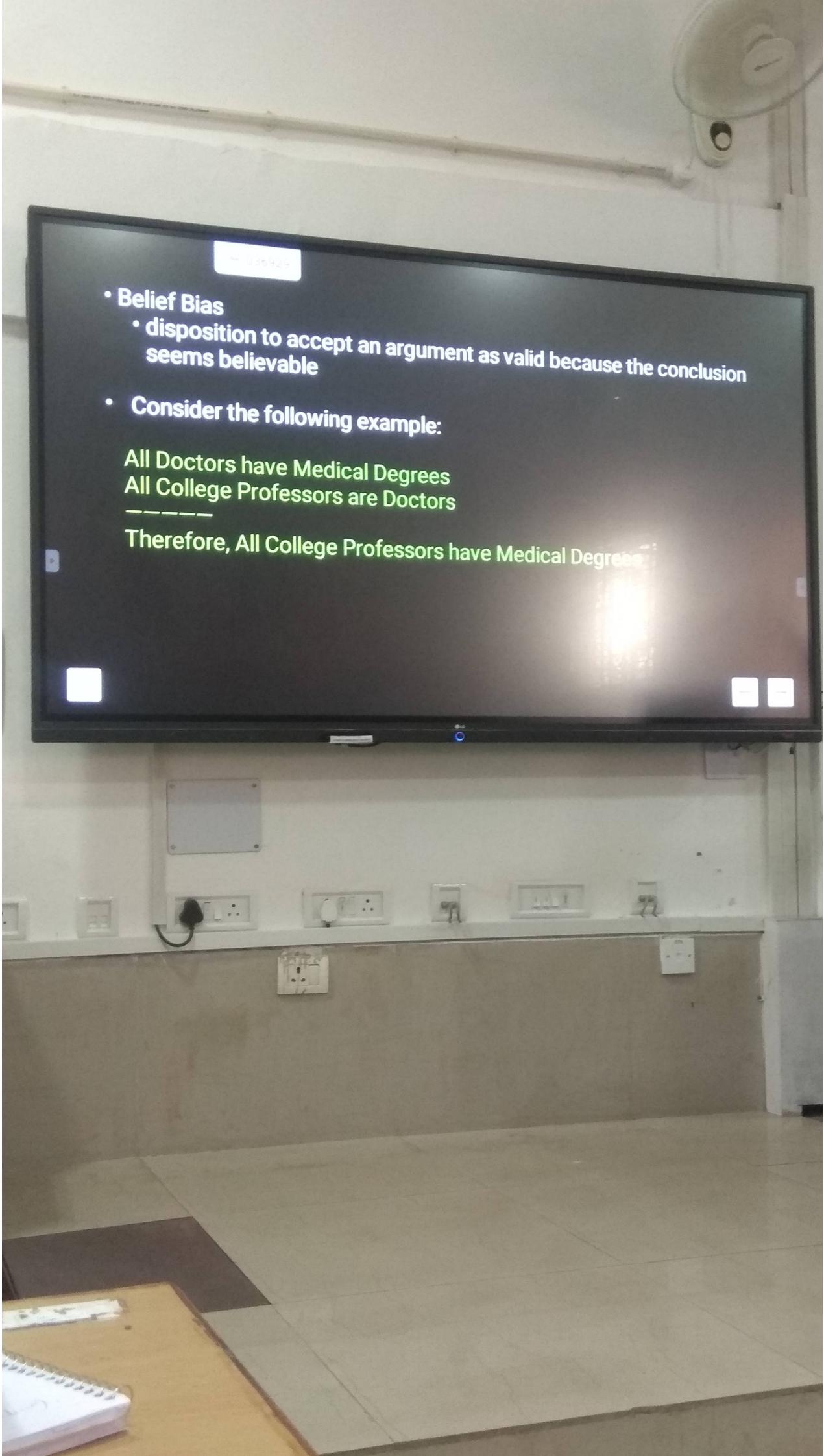
Only 47% said that the syllogism was valid.



- Belief Bias
 - disposition to accept an argument as valid because the conclusion seems believable
- Consider the following example:

All Doctors have Medical Degrees
All College Professors are Doctors

Therefore, All College Professors have Medical Degrees



SILENCE

036929

No addictive things are inexpensive

Some cigarettes are inexpensive

Therefore, some addictive things are not cigarettes

71%

No millionaires are hard workers

Some rich people are hard workers

Therefore, some millionaires are not rich people
10%



- **Belief Bias**
- disposition to accept an argument as valid because the conclusion seems believable
- It occurs both for valid and invalid conclusions
- Difference is stronger for invalid conclusions

266305

Conditional Inference

- “If P, then Q”
- Basis of hypothetical reasoning
- Conditional – major premise
- Assertion – either as True / False – minor premise

SILENCE P

Conditional Inference

- "If P, then Q"
- Basis of hypothetical reasoning
- Conditional – major premise
- Assertion – either as True / False – minor premise

SILENCE

Label	Rule	Example
Modus Ponens (MP)	If p then q; p; therefore q.	If the letter is B then the number is 3; the letter is B; therefore the number is 3.
Denial of the Antecedent (DA)	If p then q; not p; therefore not q	If the letter is Q then the number is ?; the letter is not Q; therefore, the number is not ?.
Affirmation of the Consequent (AC)	If p then q; q; therefore p.	If the letter is T then the number is 3; the number is 3; therefore the letter is T.
Modus Tollens (MT)	If p then q; not q; therefore not p.	If the letter is M then the number is 1; the number is not 1; therefore, the letter is not M.



SILENCE P

495681

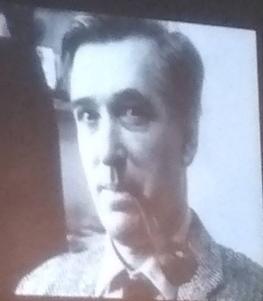
Label	Rule	Example
Modus Ponens (MP)	If p then q; p; therefore q.	If the letter is B then the number is 3; the letter is B; therefore the number is 3.
Denial of the Antecedent (DA)	If p then q; not-p; therefore not-q.	If the letter is G then the number is 7; the letter is not G; therefore, the number is not 7.
Affirmation of the Consequent (AC)	If p then q; q; therefore p.	If the letter is T then the number is 5; the number is 5; therefore the letter is T.
Modus Tollens (MT)	If p then q; not-q; therefore not-p.	If the letter is M then the number is 1; the number is not 1; therefore, the letter is not M.



SILENCE PLEASE

Wason Selection Task

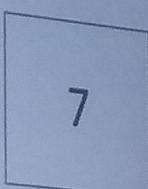
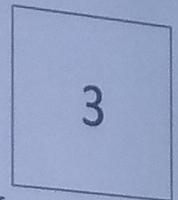
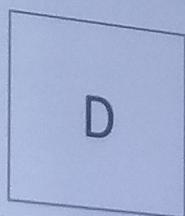
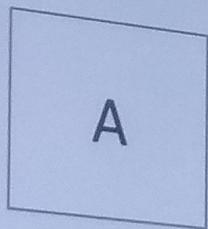
- Developed by Peter Wason - (father of psychology of reasoning)
- Known for developing several tasks that allowed testing of deduction in laboratory settings
- Tasks do not meet strict criteria for deduction as it involves hypothesis testing and reasoning



SILENCE P

430145

There are four cards lying on a table. Each has a capital letter on one side and a single digit number on the other side. The exposed sides are shown below:



The rule shown below applies to these four cards and may be true or false:

If there is an A on one side of the card, then
there is a 3 on the other side of the card

Your task is to decide those cards, and only those cards, that need to be turned over in order to discover whether the rule is true or false.

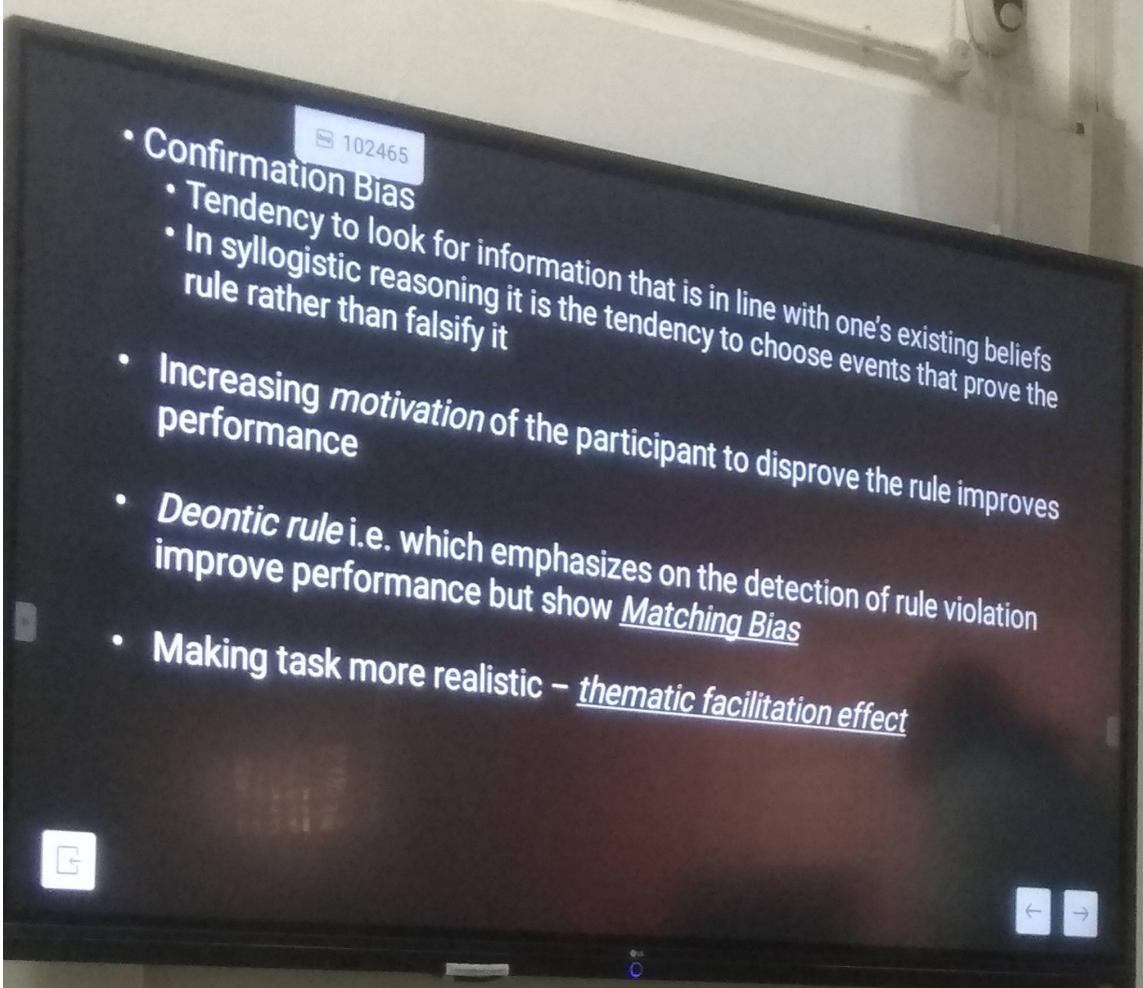
SILENCE P

- Confirmation Bias
 - Tendency to look for information that is in line with one's existing beliefs
 - In syllogistic reasoning it is the tendency to choose events that prove the rule rather than falsify it
- Increasing *motivation* of the participant to disprove the rule improves performance
- *Deontic rule* i.e. which emphasizes on the detection of rule violation improve performance but show *Matching Bias*
- Making task more realistic – *thematic facilitation effect*



SILENCE

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168001

Dawson et al. (2000)

Rule: "Individuals high in emotional liability experience early death"

Low
Emotional
Liability

High
Emotional
Liability

Early
Death

Late
Death

Result:

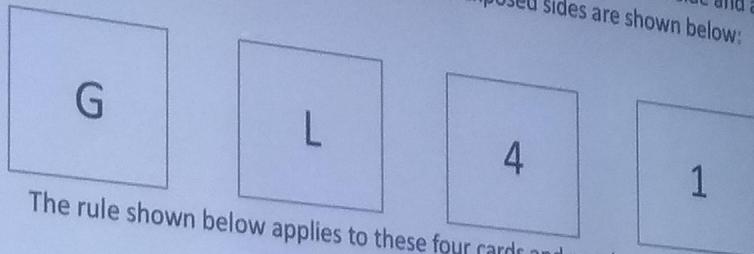
Individuals low in emotional liability - 9%

Individuals high in emotional liability - 38%

SILENCE P

168001

There are four cards lying on a table. Each has a capital letter on one side and a single digit number on the other side. The exposed sides are shown below:

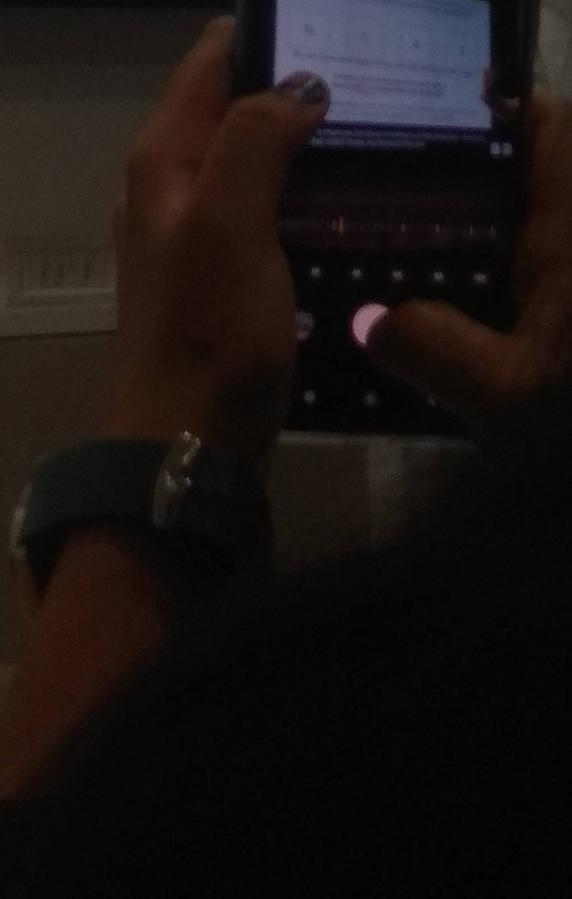
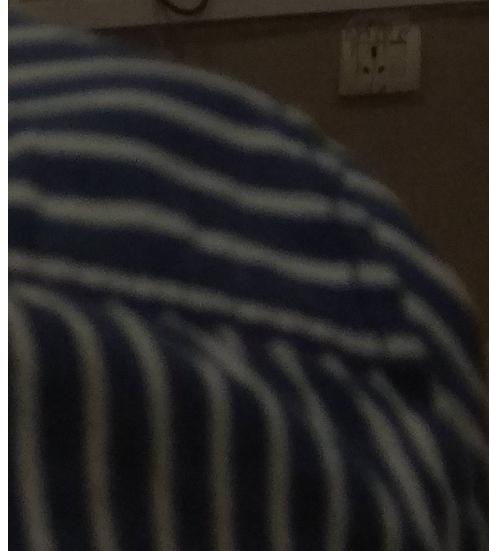
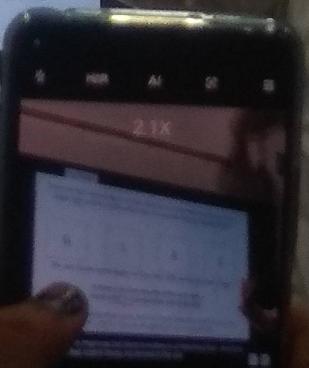


The rule shown below applies to these four cards and may be true or false:

If there is an G on one side of the card, then
there is NOT a 4 on the other side of the card

Your task is to decide those cards, and only those cards, that need to be turned over in order to discover whether the rule is true or false.

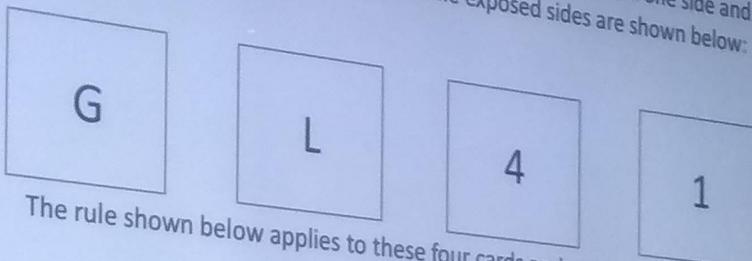
Performance improves but there is evidence of Matching bias - click the cards that match those mentioned in the rule



SILENCE

168001

There are four cards lying on a table. Each has a capital letter on one side and a single digit number on the other side. The exposed sides are shown below:



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Performance improves but there is evidence of Matching bias - choosing the cards that match those mentioned in the rule



SILENCE PLEASE

IS 160001
Imagine you are a police officer checking people drinking in a bar. It is your job to ensure that people conform to certain rules. The following cards show on one side what people are drinking and on the other side their age:

Beer

Coke

22 years

16 years

Here is a rule:

If a person is drinking beer then that person must be over 18 years of age

You must decide those cards, and only those cards, that need to be turned over in order to discover whether the rule is being violated.

Thematic Facilitation - Making the problem more realistic



SILENCE P

168001

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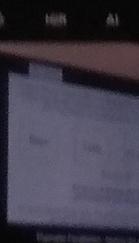
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Thematic Facilitation - Making the problem more realistic



168001

Theoretical Explanations of Deduction

- Mental Logic
- Mental Models
- Dual-Process Theory



SILENCE

Mental Logic

- Philosophers and logicians considered rules of logic as the basis of thinking
- Psychologists discovered that people had their own in-built set of rules that differed from the logic rules
 - *E.g. According to logic there should be no difference between Modus Ponens and Modus Tollens but people are better at MP*

SILENCE P

233537

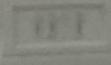
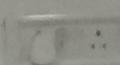
Mental Models

- Proposed by Kenneth Craik
- Developed by Philip Johnson-Laird (student of Peter Wason)
- Mental Model: Internal representation of some possible state of the world, having the same structure as that state

Kay is taller than Ray

Ray is taller Jay

What about Kay and Jay?



SWITCH

495681

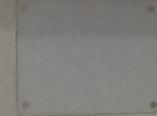
Mental Models

- How is this problem solved?
 - Using mental logic: e.g. if Kay is taller than Ray and Ray is taller than Jay, then Kay is taller than Jay
 - Mental Model: internal representations of Jay, Ray and Kay with their respective heights

495681

The Lamp is on the right of the Pad. The Book is on the left of the Pad. The Clock is in front of the Book. The Vase is in front of the Lamp.

What can you say about the clock and the vase?



OPEN

495681

- Assumptions of Mental Models
 - Mental model is constructed and conclusion generated
 - *Counter examples (i.e. where conclusions don't follow from the premise) are attempted*

X is not an adult living male? What is X?

364609

Living	Adult	Male
Living	Adult	Female
Living	Child	Male
Living	Child	Female
Dead	Adult	Male
Dead	Adult	Female
Dead	Child	Male
Dead	Child	Female

Khemlani et al., 2012 found people listing only 4 of the 7 possible categories



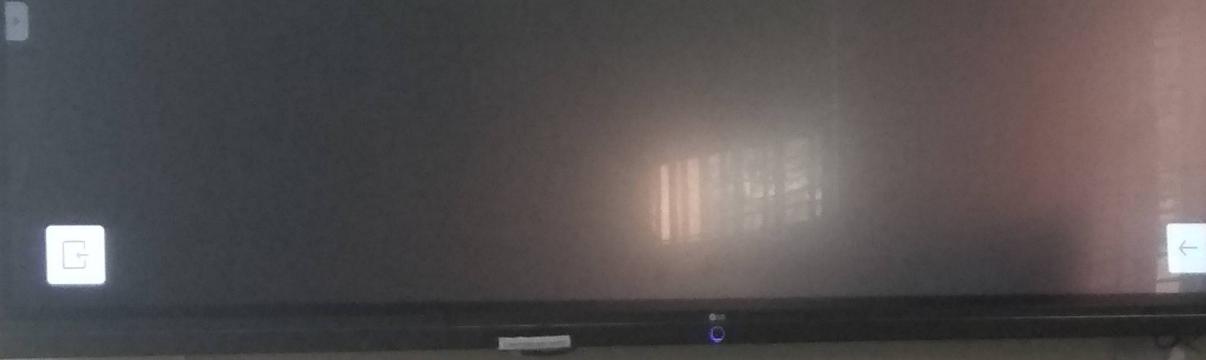
- Assumptions of Mental Models
 - Mental model is constructed and conclusion generated
 - *Counter examples (i.e. where conclusions don't follow from the premise) are attempted*
 - Mental models take up working memory
 - positive correlation (.42) with syllogistic reasoning
 - Problems requiring construction of more mental models are harder to solve
 - Models are constructed according to principle of truth

299073

Only one of the following premises is true about a particular hand of cards:

1. There is a KING in the hand or there is an ACE or BOTH
2. There is a QUEEN in the hand or there is an ACE or BOTH
3. There is a JACK in the hand or there is 10 or BOTH

Is it possible that there is an ACE in the hand?



299073

Only one of the following premises is true about a particular hand of cards:

1. If there is a king in the hand, then there is not an ace
2. If there is a queen in the hand, then there is not an ace.

Is it possible that there is a king and an ace in the hand.

Mental Models			Fully Explicit Models			
K		$\neg A$		K		$\neg A$
	Q	$\neg A$			Q	$\neg A$
				$\neg K$	Q	A
				K	$\neg Q$	A

SILENCE P

Dual Process Theories

- Several theorists - Stanovich, Evans, Sloman, Kahneman, De Neys
- Type 1 (intuitive) vs Type 2 (reflective)
- Defining features
 - Type 1: *Autonomy, No WM*
 - Type 2: *Cognitive decoupling, Needs WM*
- Characteristic features
 - Type 1: *fast, high-capacity, automatic, independent of cognitive ability*
 - Type 2: *slow, limited-capacity, controlled, dependent on cognitive ability*

SILENCE P

036929

- Assumption
 - *Default Intervention:* Reasoning performance is superior when using type 2 rather than using type 1. Type 1 produces heuristic incorrect response which is corrected by type 2
- When is Type 2 used ?
 - Reasoners are intelligent
 - Availability of time to process information
 - Reasoners are not multi-tasking



036929

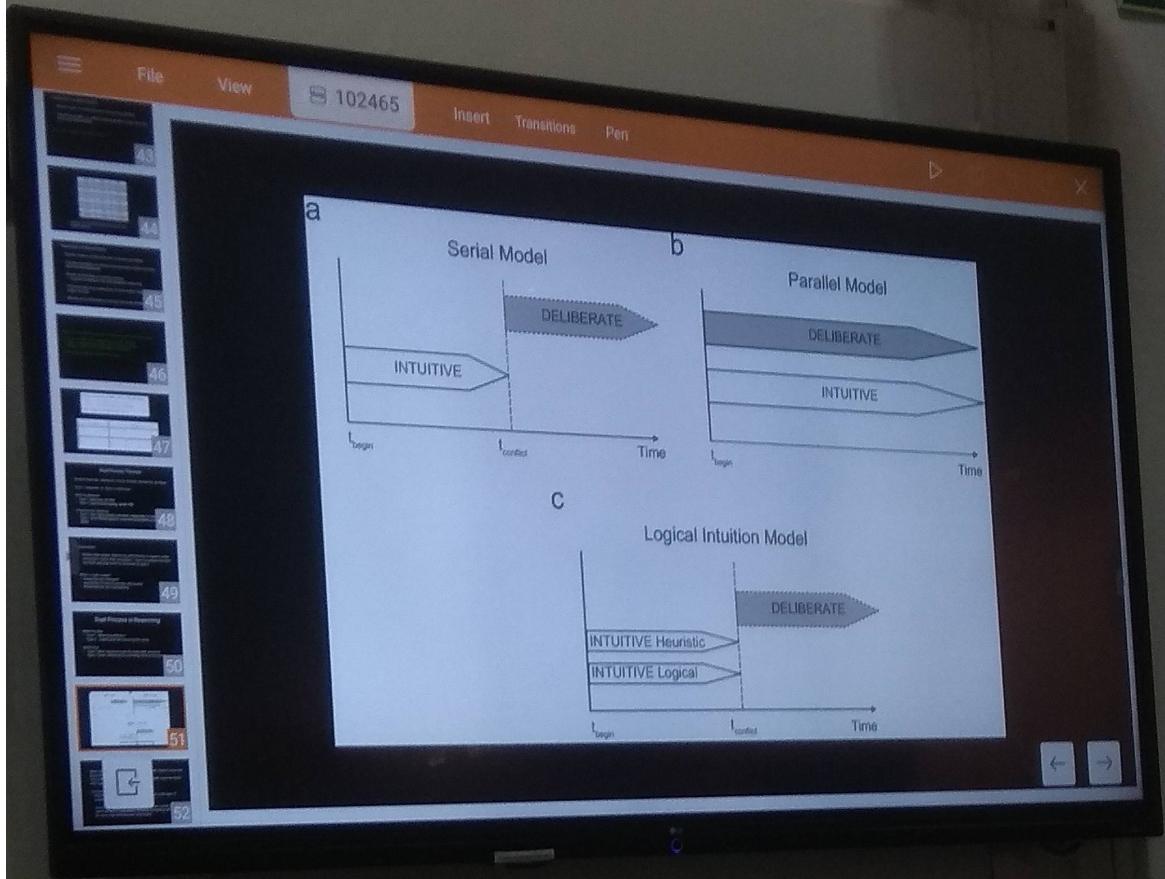
Dual Process in Reasoning

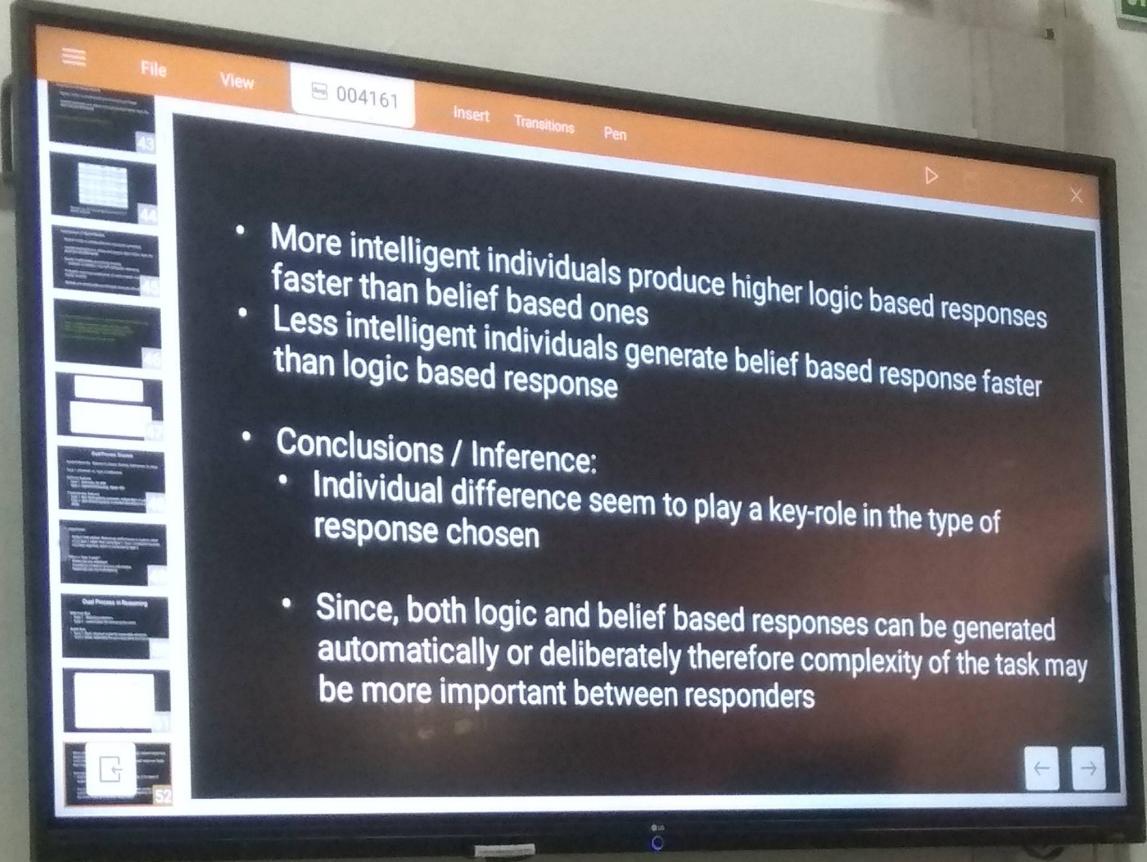
- **Matching Bias**
 - Type 1 - Matching selection
 - Type 2 - Justification for choosing the cards
- **Belief Bias**
 - Type 1 (fast, intuitive) looks for believable solutions
 - Type 2 (slow, reflective) for providing valid conclusions

SILENCE P

The image shows a presentation slide titled "Dual Process in Reasoning". The slide content is as follows:

- Matching Bias
 - Type 1 - Matching selection
 - Type 2 - Justification for choosing the cards
- Belief Bias
 - Type 1 (fast, intuitive) looks for believable solutions
 - Type 2 (slow, reflective) for providing valid conclusions





SILENCE P

SILE

Dual Process: Evaluation

- Provide explanations for a broad range of thinking phenomena - reasoning, problem-solving and decision making
- Provide specific and testable models for thinking processes
- Recent development take into account flexibility e.g individual difference, complexity etc
- Cannot explain Meta-reasoning within current theoretical framework (i.e. when does type 2 become activated?)



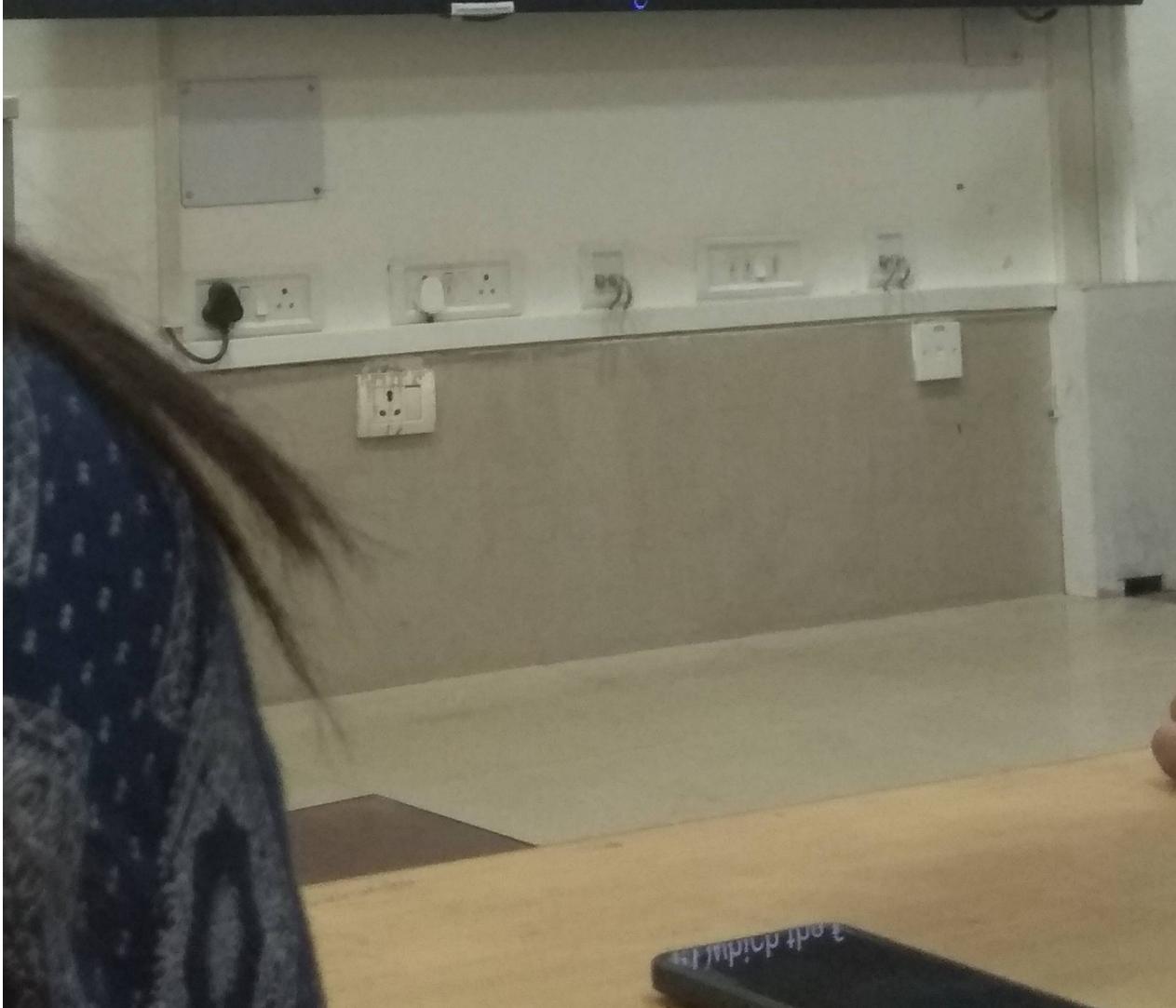
101sdom914

SILE

The slide has a dark background with white text. At the top, it says 'Meta-Reasoning'. Below that is a bulleted list:

- Monitoring processes that influence the time, effort and strategies used during reasoning
- These processes work before, during and after the task
- *Feeling of Rightness*: degree to which the first solution that comes to mind feels right. weaker this feeling greater than chances of type 2 activation

The slide is part of a larger presentation, as evidenced by the sidebar on the left which contains multiple other slides.



SILENCE

The image shows a presentation slide titled "How we Decide ?" displayed on a large screen. The slide has a dark background and contains the following text:

• Decision-making is about choosing between alternatives

• Classical Economics - Humans as Rational - MAXIMISERS

• Herbert Simon - Humans are SATISFICERS who display Bounded Rationality

• Bounded rationality is not irrationality but involves use of short-cuts in thinking - heuristics

The slide is framed by a white border, and there are navigation icons at the bottom right.



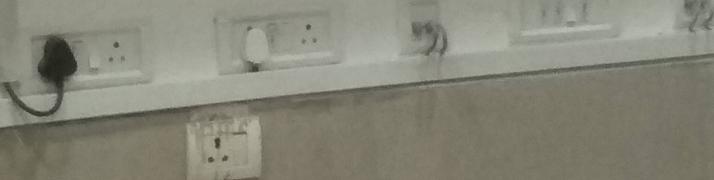
SILENCE PLEASE

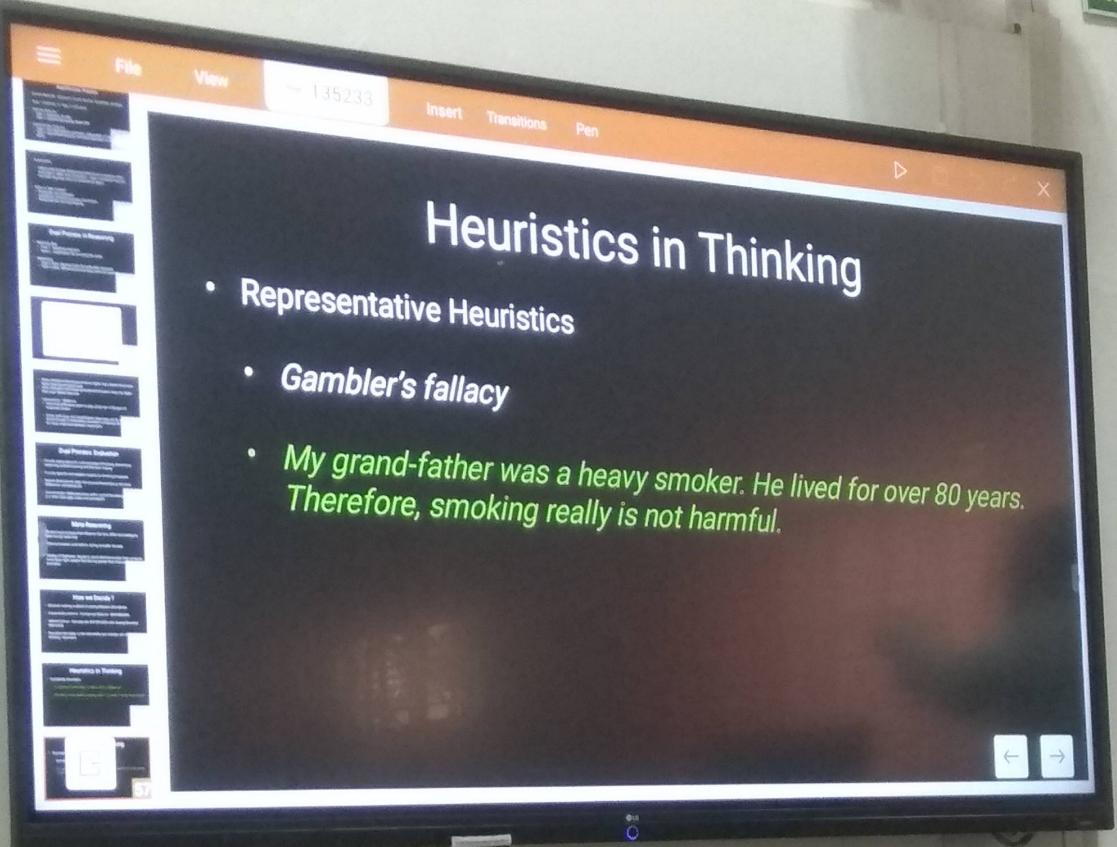
The image shows a presentation slide titled "Heuristics in Thinking". The main content area contains a bullet point under the heading "Availability Heuristics":

- *Is a person more likely to die by HIV or Malaria?*
- *Are there more words starting with 'r' or with 'r' in the third place?*

To the left of the main content, there is a vertical sidebar containing a list of cognitive biases, each with a small icon:

- Confirmation Bias
- Anchoring and Adjustment Bias
- Availability Heuristics
- Representativeness Heuristic
- Self-Perception Evaluation
- Mental Imagery
- Mental Rotation
- Framing Effect
- Loss Aversion
- Status Quo Bias
- Confirmation Bias
- Anchoring and Adjustment Bias
- Availability Heuristics
- Representativeness Heuristic
- Self-Perception Evaluation
- Mental Imagery
- Mental Rotation
- Framing Effect
- Loss Aversion
- Status Quo Bias





SILE

The slide has a dark background with white text. At the top, it says 'New Paradigm of Reasoning'. Below that, there are two main bullet points: 'Classical View' and 'New Paradigm'. The 'Classical View' section contains three sub-points. The 'New Paradigm' section contains four sub-points, with the last two being nested under a bullet point 'Reasoning involves determining:'.

- Classical View
 - During reasoning people are drawing logical inferences
 - Reasoning involves determining truth and falsity of arguments
- New Paradigm
 - People naturally reason from their beliefs and this should not be considered an error or cognitive bias
 - During reasoning people are making decisions
 - Reasoning involves determining:
 - What is believed and to what extent ? (Degree of Belief)
 - What is its value ? (Utility)

View

397377

Insert

Transition

Pen

Familiar paradigm task

A

7

If there is an A on the left, then there is a 7 on the right.

Johansen-Larsen & Tugert, 1969.

TRUE / FALSE / IRRELEVANT

Familiar paradigm task

What is the probability that the following events will occur in the UK within the next ten years?

Global warming continues and London gets flooded.

Global warming continues and London does not get flooded.

Global warming does not continue and London gets flooded.

Global warming does not continue and London does not get flooded.

Ouer et al., 2007

100%



SILENCE PLEASE

The slide has a dark background with white text. At the top, there is a navigation bar with 'File', 'View', a document icon labeled '397377', 'Insert', 'Transitions', and 'Pen'. Below the navigation bar is a list of bullet points:

- New Paradigm does not depend on the binary of Truth / Falsehood
- Conditionals are evaluated using 'degree of belief' - expressed as probability
- Suppositional Conditional v Material Conditional

Below the list is a green text box containing the sentence: "If there is a vowel, then the number is 5".

Vowel	5	True
Vowel	Not-5	False
Not-Vowel	5	True
Not-Vowel	Not-5	True

The slide has a dark background and an orange header bar. The header bar contains the text 'File View 266305 Insert Transitions Pen'. On the left side of the slide, there is a vertical sidebar with several small, illegible icons or thumbnails.

- Material conditional is true whenever antecedent is false or consequent is true, then:
If 2+2=5, then 3 is an odd number
If Maradona is an Indian, then Argentina won the world cup
- Ramsey Test
 - A conditional is not material but suppositional, therefore, the probability of the consequent is evaluated assuming the antecedent has already happened

SILENCE

