

## **Outline**

- 1. Induction vs Deduction**
- 2. Attributes of Induction**
- 3. Types of Induction**

*Dogs have TWO eyes*

*Cats have TWO eyes*

*Birds have TWO eyes*

*Lizards have TWO eyes*

*Cows have TWO eyes*

*Fish have TWO eyes*

*Pornography like drugs is harmful  
because it is addictive*

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*Therefore, animals have TWO eyes*

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Basis of Comparison	Inductive Reasoning	Deductive Reasoning
Typical Direction	Specific to general	General to specific
Type of Premise	Observations and patterns	General principles or facts
Common Type of Process	Often fast and automatic	Often slow and conscious
Conclusions	Go beyond the premises	Follow from the premises
Evaluation	Weak to strong arguments	Invalid/valid conclusions
Best Outcome	Highly likely to be true	Logically true and sound

SILE

## Induction in Everyday Life

- Because the clouds are quite dark today, it is likely to rain.
- Tata has produced excellent cars, so their tea-bags will be good as well.
- Most people I met in India drank tea, therefore most Indians prefer tea.

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## Strong Inductive Arguments

- All dinosaur bones discovered to this day have been at least 50 million years old. Therefore, probably the next dinosaur bone to be found will be at least 50 million years old
- All meteorites found to this day have contained silver. Therefore, probably the next meteorite to be found will contain silver.

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## Weak Inductive Arguments

- Amul lassi sells for 20 rupees, therefore amul buttermilk would also sell for 20.
- During the past thirty years, inflation has consistently reduced the value of the Indian rupee. Therefore, India's GDP is likely to increase in the near future.



SILENCE

## Strength : A Matter of Degree

This barrel contains 100 apples.  
Three apples selected at random were found to be ripe.  
Therefore, probably all 100 apples are ripe.

This barrel contains 100 apples.  
Eighty apples selected at random were found to be ripe.  
Therefore, probably all 100 apples are ripe

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## Induction

- Induction is the process of drawing generalizations from specific observations
- Utility
  - Explanation: categorization, causal inference, analogy
  - Reducing Uncertainty

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## Attributes of Induction

- Large Sample
  - Maximizes information, reduces distortions
  - Premise monotonicity
- Diverse Evidence
  - Counter biases – Availability Heuristics, Illusory Correlation and Confirmation Bias
  - Eliminative induction – seek both confirming and disconfirming evidence

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## Wason, 1960 - "2-4-6 Task"

Trial	Participant's # Sets	Type of Feedback	Current Hypothesis	Strategy	Overall Induction Type
1	4-6-8	"Yes"	Even & Increasing by 2s	To confirm	Enumerative (only confirming)
2	6-8-10	"Yes"	Even & Increasing by 2s	To confirm	
3	20-22-24	"Yes"	Even & Increasing by 2s	To confirm	
4	8-10-12	"Yes"	Increasing by 2s	To confirm	
Participant never gets the correct rule.					
1	22-24-26	"Yes"	Increasing by 2s	To confirm	Eliminative (both confirming & disconfirming)
2	6-4-2	"No"	Increasing by 2s	To disconfirm	
3	1-17-23	"Yes"	Ascending #s	To confirm	
4	3-2-1	"No"	Ascending #s	To disconfirm	
Participant announces the correct rule.					



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- **Diverse Evidence**

- Counter biases – Availability Heuristics, Illusory Correlation and Confirmation Bias
- Eliminative induction – seek both confirming and disconfirming evidence
- Premise can influence which knowledge will be retrieved
- But past experience can influence which knowledge is available (difference between novices and experts)

- **Representative Observations**

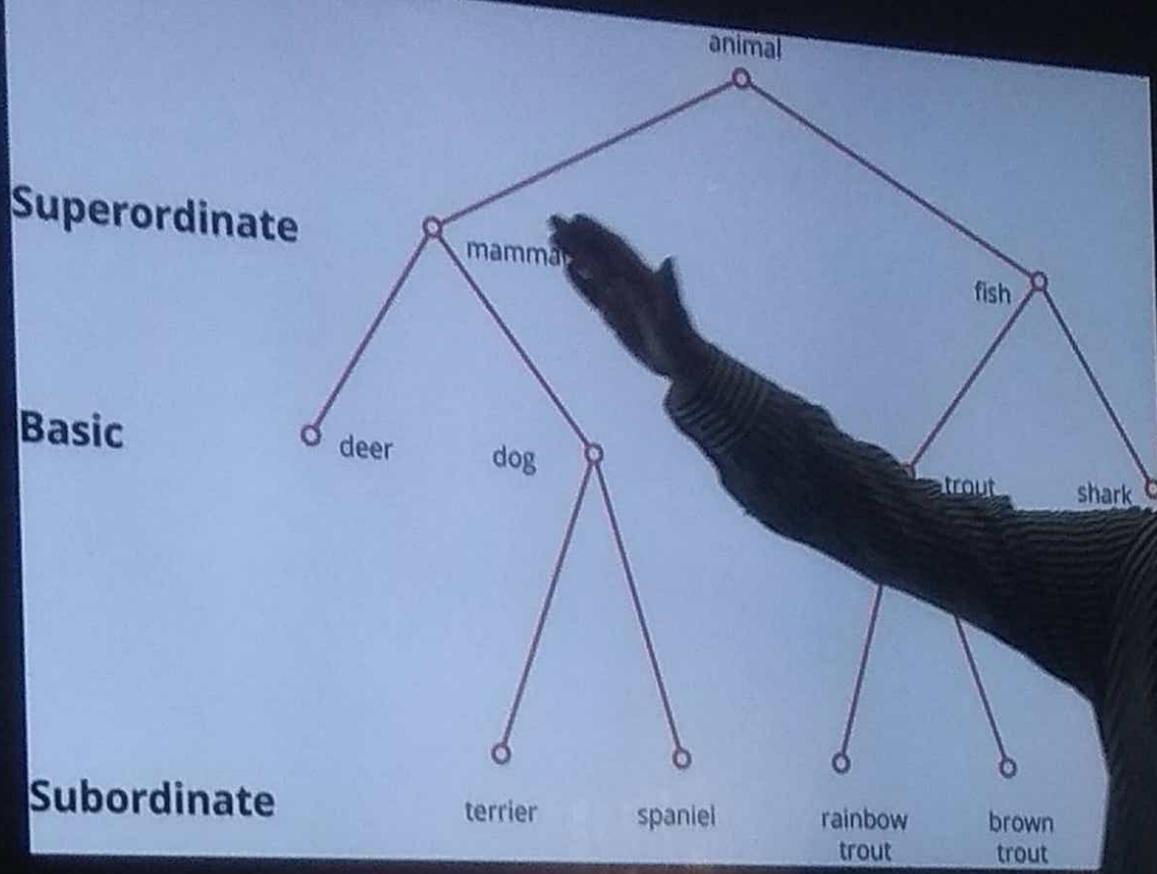
- Sample need to closely resemble the population

## Types of Induction

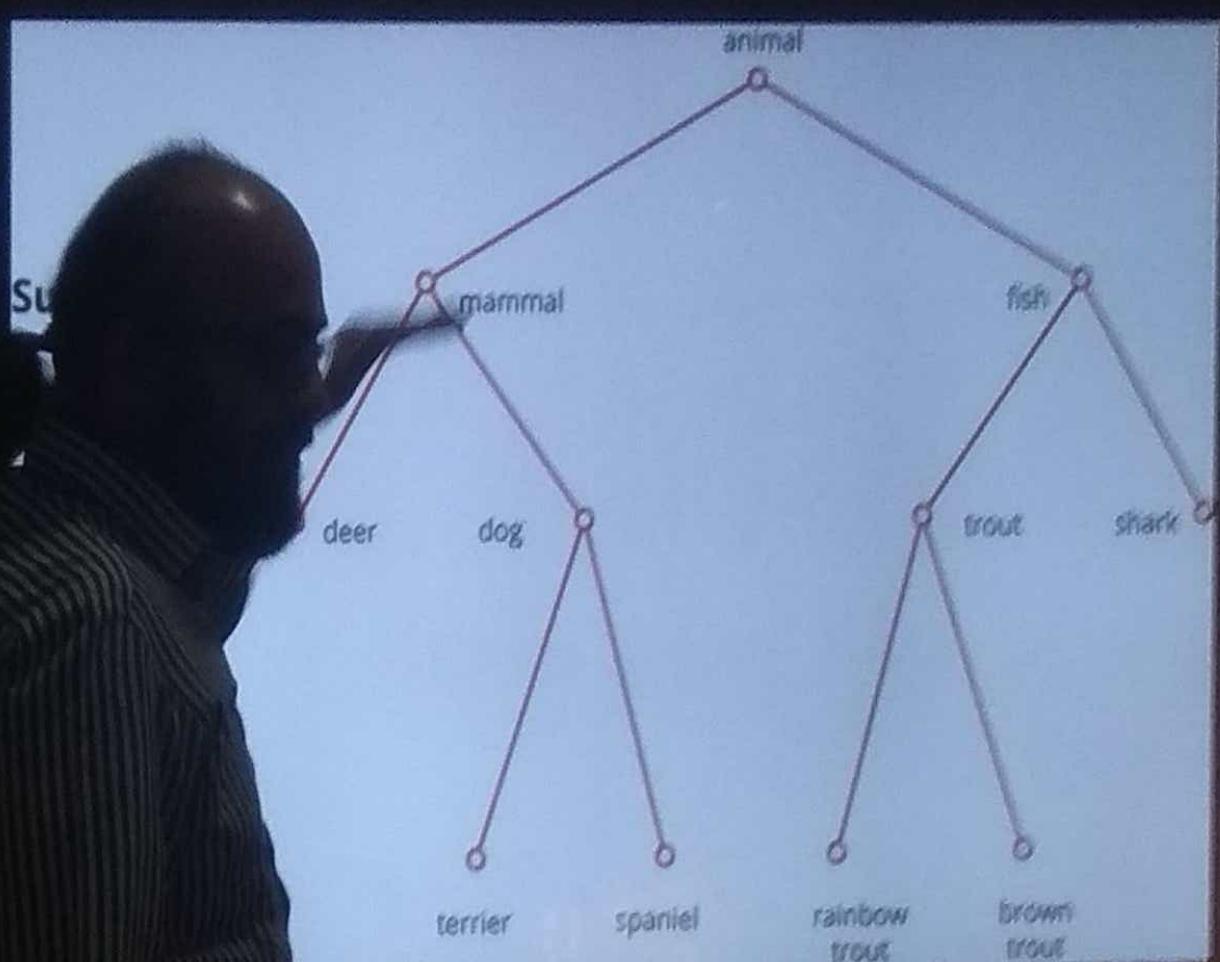
- Category-based
- Causal
- Analogical Reasoning

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- Cat
- Cat
- Ana



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## Category-based Induction

- Judging presence of a property in the conclusion category, if the premise categories also have that property
- Argument
  - Premise – containing predicates (properties)
  - Conclusion – inference drawn

"Cats can jump on high walls. Therefore leopards can also jump on high walls"

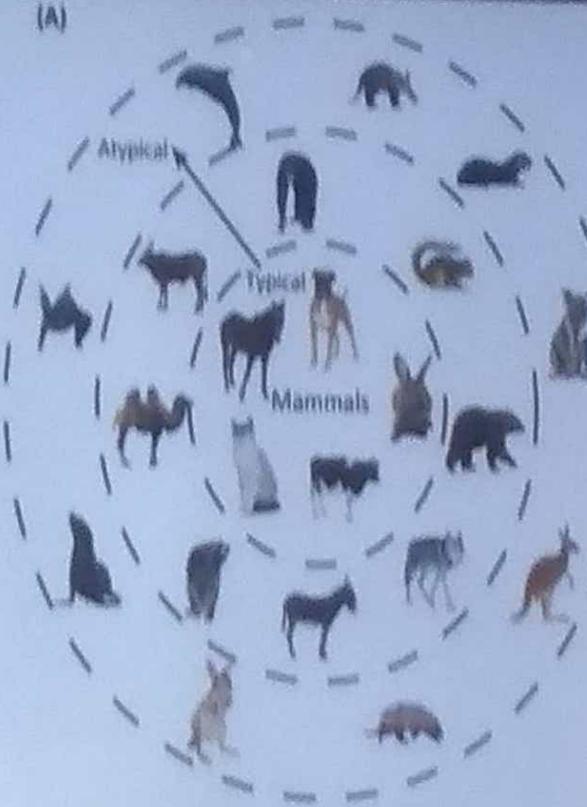
- Blank Predicate – forces use of induction

"Cats have a scapula. Therefore leopards also have a scapula"

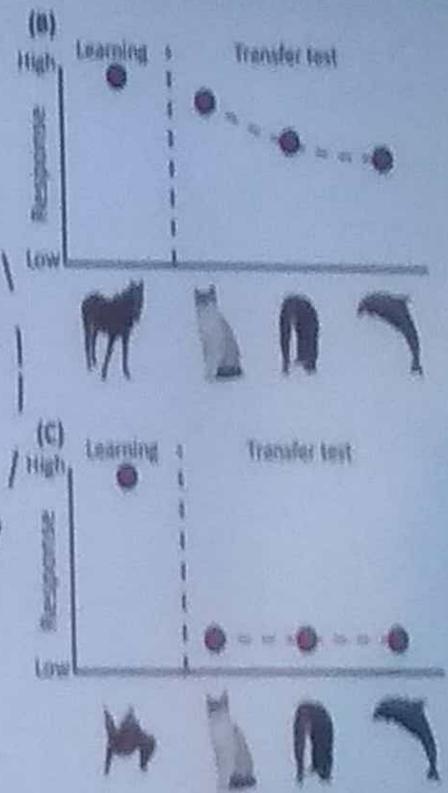
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- Lance Rips, 1975
- ***Participants are told that one or more categories of animals have a disease. They are then asked to judge the proportion of animals in another category (species) that have the disease***
- Prior to the experiment the similarity of species to one another had been rated as well as the similarity to superordinate category (e.g. Mammal)
- Similarity and Typicality were found to influence judgment

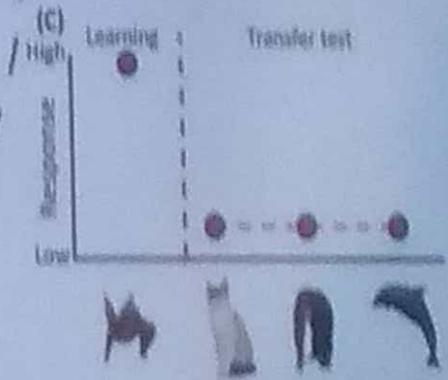
(A)



(B)



(C)



TRENDS in Cognitive Sciences

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- Premise Similarity
- Also category similarity or Premise-Conclusion Similarity
- Perceived similarity between premise and conclusion category strengths  
inductive arguments
- Likelihood of generalizing a novel property to other category increases

Dogs have high concentration of iron in their blood. Therefore cats have high concentration of iron in their blood

Pigs have high concentration of iron in their blood. Therefore cats have high concentration of iron in their blood

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- Premise Typicality
- Higher the representativeness of a species to an inferred superordinate category, faster the induction
- The premise category should be more typical of its superordinate category

Pigeons have high concentration of iron in their blood. Therefore all birds have high concentration of iron in their blood

Penguins have high concentration of iron in their blood. Therefore all birds have high concentration of iron in their blood

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- Premise Diversity
- Arguments are stronger if dissimilar sub-ordinate categories are used as evidence

Lions and Goats have the xaxa disease, therefore all mammals have the xaxa disease

Lions and Tigers have the xaxa disease, therefore all mammals have the xaxa disease

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- Premise Diversity
  - Also facilitates horizontal transfer

Cow and goat have this disease, therefore Elephant also has this disease

Cow and lion have this disease, therefore Elephants also have this disease



- Inclusion Fallacy

- Tendency to discount conclusions for which there is not a strong similarity
- Sometime overtakes categorical membership as well

Cows have got a spatula bone, therefore all mammals have a spatula bone

Cow have a spatula bone, therefore dolphins have a spatula bone

## Causal Induction

- Involves finding potential cause for observed effects
- Exert powerful effects and dominate most other forms of induction

Dears contain the protein retinum. Therefore, tigers contain the protein retinum.

Lions contain the protein retinum. Therefore, dears contain the protein retinum.

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- **Methods of Causal Analysis**
  - **Method of Agreement**
  - **Method of Disagreement**
  - **Joint Method**
  - **Method of Concomitant Variation**

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- Method of Agreement
- If there is only one common factor for all observed cases of a phenomenon, then the common factor is the likely cause

Member	Salad	Bread	Fish	Pie	Ill?
Mom	Yes	No	Yes	No	Yes
Dad	Yes	No	Yes	No	Yes
Brother	No	No	Yes	Yes	Yes
You	Yes	Yes	Yes	Yes	Yes
			Yes	Yes	Yes

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- Method of Disagreement

- If a phenomenon occurs in only observed case and not in another and there is only one *circumstance* that differs among them, then this *circumstance* is the likely cause

Member	Salad	Bread	Fish	Pie	Ill?
Mom	Yes	No	Yes	Yes	Yes
Dad	Yes	No	Yes	Yes	Yes
Brother	No	Yes	Yes	Yes	Yes
You	No	Yes	Yes	No	No



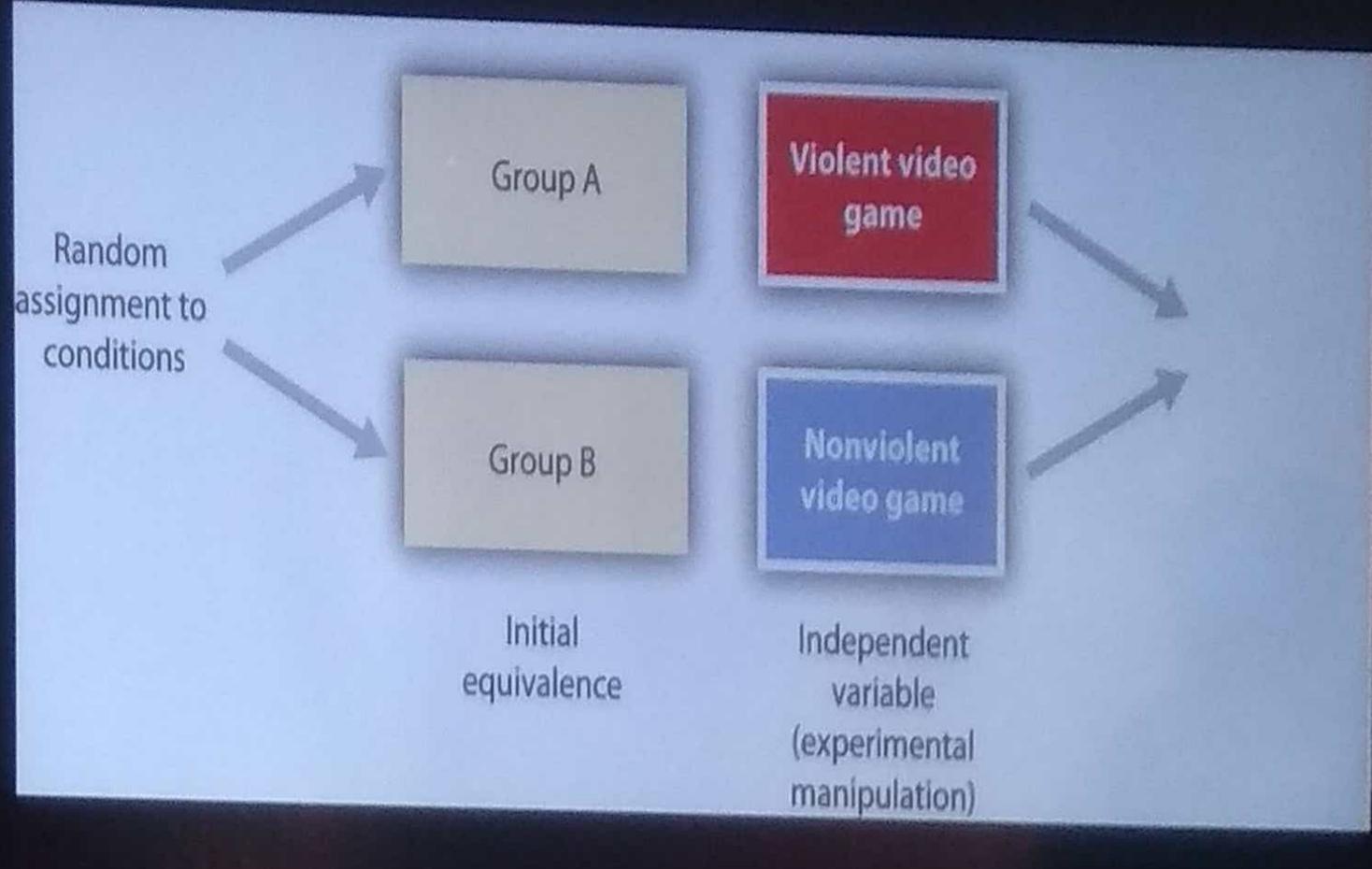
- Joint Method

- Combines methods of agreement and disagreement in case of presence of phenomena in some but not others.

- Experimental Method

- Control Group

- Experimental Group



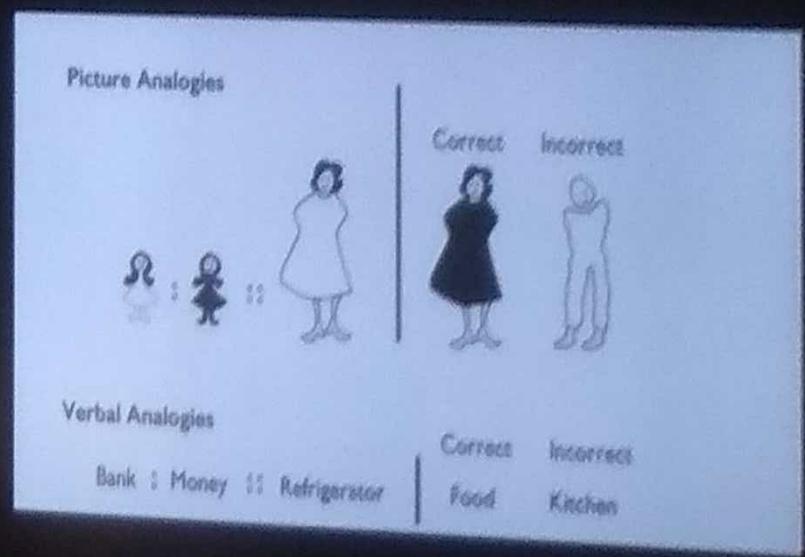
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- Method of Concomitant variation
  - If there is a high correlation in the variation occurring for two different phenomena, one phenomena is likely to be the cause of the other or third unknown variable might be the cause of both
- Establishing causation requires:
  - Correlation
  - Temporal precedence of the cause
  - Rejection of alternate causes

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# Analogical Reasoning

- Reasoning by comparing two domains of knowledge in order to infer a quality they have in common
- Used both in image and verbal form



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## Steps in Analogical Reasoning

A Lawyer is to trial as surgeon is to:

- A. stethoscope
- B. medical school
- C. operation
- D. patients

# Steps in Analogical Reasoning

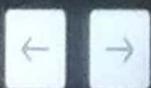
Encoding	<i>Recalling mental representations of lawyer and trial-base terms</i>
Inferring	<i>Guessing relations between the base terms (lawyers engage in trials)</i>
Mapping	<i>Encoding target term (surgeon) and identifying parallels between it and the base term (lawyer)</i>
Applying the Relation	<i>Relation between base terms is then extended to target term (lawyer does trial, surgeon does..?)</i>
Response	<i>Preparing a response 'Operation' (surgeon performs work during operation like lawyer does during a trial)</i>



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# Theories of Induction

- Similarity-Coverage Model
  - similarity between premise and conclusion facilitates induction
  - Degree of coverage (category) of the premises facilitates induction
  - Explains various findings like premise similarity, diversity, typicality.
  - Fails to explain inclusion fallacy



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- Feature Coverage Theory

- similarity plays an important role in induction but category inclusion does not
- Similarity and category coverage are replaced with 'feature coverage'
- Dissimilar premises tend to activate more features hence stronger diversity effect
- Explains most effects observed in induction including induction fallacy



All Men are Mortal  
Socrates is a Man

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*Socrates is Mortal*

All Men are Mortal  
Socrates is a Man

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Socrates is Mortal  
Socrates is a Man

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*Socrates is Mortal*

*All Men are Mortal*

All Men are Mortal  
Socrates is a Man

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Socrates is Mortal  
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All Men are Mortal  
Socrates is Mortal

---

*Socrates is Mortal*

*All Men are Mortal*

*Socrates is a Man*

# Explanation and Inference

- Under-determination in Everyday Reasoning:
  - Many hypothesis are possible based on our knowledge of the world

*Why is the train not on time?*

*Why are exams scheduled even on Sundays?*

*How did the dog go missing?*

*How to boost the economy post-pandemic?*

- Reliance on the best guess is the 'best' explanation

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- What constitutes a good explanation?
  - Quality of an Explanation
  - Probability of it being correct
- Factors influencing quality:
  - *Simplicity*
  - *Breadth*
  - *Consistency with prior knowledge*
  - *Coherence*

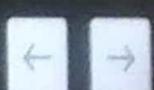
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## Lombrozo, 2007

- Adults participants learned about a new disease and symptoms. They were told about a patient had two symptoms that could be explained by having:
  - *Single disease with both symptoms (simple)*
  - *Two diseases with a symptom each (complex)*
- Participants preferred the simple route

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- Provided base-rate information about two diseases
- Participants chose complex explanation when it seemed more probable than simpler explanation
- Simplicity is often taken as an indicator of probability !



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