Week 12.1

Reasoning

11/12/2018
Roadmap

• Intelligence
• Why study reasoning
• Deductive vs. Inductive reasoning
  ➢ Syllogism
  ➢ Propositional reasoning
• Inductive reasoning
  ➢ Analogical
  ➢ Hypothesis testing
Learning objectives of the day

1. What’s the difference between fluid and crystallized intelligence?
2. How is intelligence measured?
3. What’s the difference between deductive and inductive reasoning?
4. What are syllogism and propositional reasoning?
5. What are the two types of errors in hypothesis testing?
6. What’s the role of language on reasoning?
Problem-solving and intelligence

• Fluid intelligence
  ➢ Ability to solve new problems

• Crystallized intelligence
  ➢ Ability to solve similar problems that you encountered before
Measuring intelligence

• Verbal, spatial, numerical

• General Intelligence: Common factor across the board

• Wechsler Intelligence Scale for Children (WISC)

• Wechsler Adult Intelligence Scale (WAIS)
Intelligence

Reisberg (2018)
Answering a question on an IQ test:

• Problem-solving

• Reasoning

• Decision making
Reasoning

• Philosophy
• Formal semantics
• Psychology
• Computer Science

```matlab
if any(A > limit)
    disp('There is at least one value above the limit.')
else
    disp('All values are below the limit.')
end
```

https://www.mathworks.com
Deductive vs. Inductive reasoning

• Deductive
  Premises $\rightarrow$ conclusions

• Inductive
  Inference from available information $\rightarrow$ possible outcomes
Deductive reasoning – categorical syllogism

Leibniz, Boole and Gödel worked with logic.
I work with logic.
I am Leibniz, Boole and Gödel.
Deductive reasoning – categorical syllogism

Some professors are tall.
Some tall people are fat.
Is it always true that “Some professors are fat”? 
Some professors are tall.
All tall people are fat.
→ Is it always true that “Some professors are fat”?
Deductive reasoning – propositional reasoning

- Proposition: the fact or assertion that you can infer from the sentence

‘Martin has two children.’
‘His daughter is turning 8 this weekend.’
‘His son is very naughty.’
Deductive reasoning – propositional reasoning

• Do these sentences have the same proposition?

‘He ate two cookies.’
‘What he ate were two cookies.’
‘Two cookies were eaten by him.’
‘Two cookies were what he ate.’
‘Two cookies he ate.’
Propositional reasoning: Four-card task

• If a card has a consonant on one side, it must have an odd number on the other side. Which card(s) would you flip in order to test if the rules are true?
Four-card task: Content effect

• If a person is drinking beer, s/he must be over 21 yo. Which card(s) would you flip in order to test if the rules are true?

22 years old  16 years old  Drinking beer  Drinking coke
Inductive reasoning – analogical reasoning

• Inference based on an established relationship between two premises

• Dog: Lab = Bird: ___.
• Car: ground = ____: sky
Inductive reasoning- Raven’s Progressive Matrices
Language and reasoning: Raven’s progressive matrices

• Case study: “Chelsea” -- deaf and language impaired
Language and reasoning: Raven’s progressive matrices
• Implication from Chelsea’s case
  ➢ The role of language on general intelligence
  ➢ Is language really not required for the Raven task?
Inductive reasoning: Hypothesis testing

“If people eat 5 meals a day, they might be more productive and able to maintain high arousal level throughout the day.”

• Design a simple experiment to test this hypothesis.

• Can you justify that your results can prove the hypothesis to be true?
Inductive reasoning: Hypothesis testing

• Hypothesis
  Higher IQ test scores is correlated with better reasoning skills

• Null hypothesis ($H_0$)
  Higher IQ test scores is NOT correlated with better reasoning skills
Hypothesis testing

• Type I error
  ➢ Reject null hypothesis when it is true (i.e., falsely accept the hypothesis)
  ➢ An accidental finding of correlation between IQ and reasoning from a small sample size when there is NO correlation
Hypothesis testing

• Type II error
  - Accept null hypothesis when it is NOT true (i.e., falsely reject the hypothesis)
  - An accidental finding of no-correlation between IQ and reasoning when there IS actually a correlation
Confirmation bias

• Choose the evidence that supports our claims
• Tendency to ignore counter-evidence
• Tendency to remember supportive evidence better than counter-evidence
• Tendency to ignore alternative hypotheses
Quick review for Quiz 3
Covers materials from Lecture 9 through today’s lecture.

• Different theories of concept
• Concept and mental imagery
• Mental rotation
• Finke’s principles of visual imagery
• Dual coding theory
Quick review for Quiz 3

• Language vs. animal communication
  ➢ Features
• Subfield of linguistics
• Chomsky vs. Skinner
• Cognitive approaches to language
• Language and thought
• Speech perception
Quick review for Quiz 3

• Frequency effect on perception and comprehension
• Broca’s vs. Wernicke’s area
• Aphasics’ thinking performance
• Sapir-Whorf hypothesis
• Problem solving strategies
• Functional fixedness and mental set
• Divergent vs. Convergent thinking
• Today’s lecture...