Continued from Tuesday...

Study puzzle

Start at Phil's house. At first, you can only make right turns through the maze. Each time you cross the red zigzag sign (under Carl's auto repair), the direction in which you turn changes. So, after the first time you cross that sign, you can then only make left turns; after the second time, you switch back to right turns only, etc. How can Carl's auto repair be reached?

Incubation

Time away from a problem provides new insights, or otherwise facilitates, the problem solving process.
Silveira's (1971) incubation experiment

- You are given four separate pieces of chain that are each three links in length. It costs 2c to open a link and 3c to close a link. All links are closed at the beginning of the problem. Your goal is to join all 12 links of chain into a single circle at a cost of no more than 15c.

Results

- Control group: worked for half hour
  → 55% solved it
- Experimental group 1: worked half hour interrupted by half hour break
  → 64% solved it
- Experimental group 2: worked half hour interrupted by four hour break:
  → 85% solved it

Incubation

- Time away from a problem provides new insights, or otherwise facilitates, the problem solving process. How does this work?

  1) release from a problem solving set, or functional fixedness
  2) retrieval of new information by changing context
  3) recovery from fatigue conscious problem solving in the interim

Inductive Reasoning: Hypothesis Testing

Deductively valid?

Premise: All cars have wheels
Premise: All wheels are round
Conclusion: All cars have round wheels

Premise: I have a diamond
Premise: Most diamonds are shiny
Premise: My diamond is shiny

Premise: John is 93
Conclusion: John will not do a double back flip today

Inductive vs. Deductive Reasoning

• Deductive reasoning:
  – conclusion follows logically from premises

• Inductive reasoning:
  – conclusion is likely based on premises.
  – involves a degree of uncertainty

• Most reasoning in real-world is based on induction
  – How do people reason with uncertainty?
  – What is the right way to reason with uncertainty?
Inductive Learning Tasks

- Concept learning:
  - inducing learning rules to classify objects
  - inducing rules about numbers
- Judging likelihood of events (next week)
- Language learning: induction of meaning (next week)

Variations of Concept Learning

- Concept formation vs. concept identification:
  - Concept formation: relevant dimensions unknown
  - Concept identification: set of dimensions is given
- Learning from positive examples only vs. including negative examples
- Reception method (passive learning) vs. Selection method (active learning)

"DAX" = Food? Vegetables? Vegetables or Cans? All things in a picture? All things that can be held? All round things?
How to choose between competing hypotheses?

**Occam’s razor:** everything else being equal, simpler hypotheses should be preferred over more complex hypotheses.

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**Concept Identification**

Using conjunctions and disjunctions

- John
- Martha
- Rob
- Peter
- Elwood
- Jake

→ **YES**

→ **NO**

NO GLASSES AND SMILING

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**Difficulty of Concept Learning**

- Concept Learning becomes more difficult with:
  - More dimensions
  - More feature values
  - Disjunctive rules (compared to conjunctive rules)

  Disjunctive: smiling OR glasses
  Conjunctive: smiling AND glasses

  - Absence of negative examples
Concept Identification & Reception Method

Dimensions and feature values:
- color=green or red
- size=large or small
- shape=square or circle

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<tr>
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<th>Green small circle</th>
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Continuity Theory

- Subject forms *response hierarchy*
- Tallying number of times a category response has been associated with an attribute
- Predicts *gradually* changing associations (not rule like)

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<td>Green = 4+ and 3- Large = 7+ and 0- circle = 4+ and 3- Total = 15+ and 6- → “yes”</td>
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Noncontinuity Theory (rule learning)

- Discontinuous process of proposing and rejecting rules; hypothesis testing
- Example strategy: win stay, lose switch

Win Stay, Lose Switch

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Testing Continuity/Discontinuity Theories

Trial 1

Trial 2

Transfer trial 1

Transfer trial 2

Reversal Shift

Intradimensional Shift
Predictions & Results

• Continuity theory predicts reversal shifts more difficult to learn → changing more associations

• Noncontinuity theory (rule learning) predicts reversal shifts easier to learn → just flip responses

• Result: Reversal shifts easier to learn except for children under 5 years of age

• Conclusion: as age increases, concept learning becomes more rule-like.

Bower & Trabasso

• Another test of rule vs. association based concept learning theories

• Rule based theory predicts: changing concept rule does not hurt learning when correct rule has not been induced yet

• Association theory: changing concept rule disrupts learning as associations are slowly built up

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### Results

- Changing concept rule before it was induced by subjects did not hurt performance

> Concept learning appears rule like.

### Selection Method (Active Learning)

- 2-4-8 is a set of numbers that conforms to a rule.

- Discover the rule by querying with any set of three numbers and I’ll give feedback whether it is a positive or negative example.
Wason Selection Task

E K 4 7

“If a card has a vowel on one side, then it has an even number on the other side”

Which cards do you need to turn over to test the correctness of the rule?

DEDUCTIVE INTERPRETATION

Answer: 
- 89% correct – strategy to confirm rule
- 16% irrelevant
- 62% irrelevant
- 25% correct – strategy to disconfirm rule – subjects rarely pick this

Confirmation Bias

- Wason (1960): subjects test hypotheses by generating positive rather than negative examples
- Popper (1959): confirmatory strategies provide ambiguous information. The hypothesis may be correct or another hypothesis may be correct → scientists should try to falsify their theories