Thinking and intelligence

Review: The cognitive perspective

Psychological approach that emphasizes what goes on in people's heads

This perspective involves

Reasoning, memory, language, learning, problem-solving, decision-making

Behaviorism focused on outcomes

Social-cognitive learning theories are an extension

Overview

- Thought: Using what we know
- Reasoning rationally
- Barriers to reasoning rationally
- Intelligence
- The origins of intelligence
- Animal minds

Concept Map

Elements of cognition

Concept

Mental category that groups objects, relations, activities, abstractions, or qualities having common properties

Basic concepts have a moderate number of instances and are easier to acquire.

A *prototype* is an especially representative example.

Proposition

A meaningful unit, built of concepts, expressing a single idea

Schema

An integrated mental network of knowledge, beliefs, and expectations concerning a particular topic.

Image

A mental representation that resembles what it represents

Mental representation

- **Concept** – classical music
- **Prototype** – Beethoven's Moonlight Sonata
- **Proposition** – classical music is relaxing
- **Schema** – beliefs about what classical musicians do, how they are trained, what listeners are like, etc.
- **Image** -

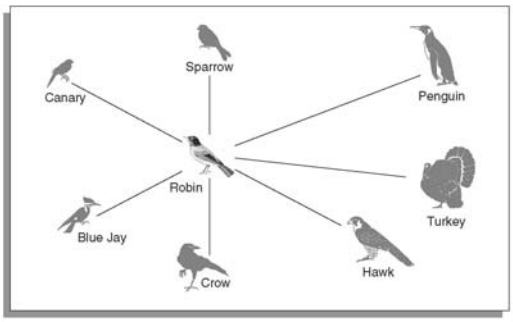

Figure 7.2 Typicality of members in a basic-level category.

"Debby donated a big amount of money to Greenpeace, an organization which protects the environment"

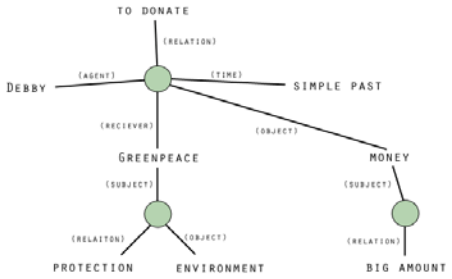

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Table 5.1

The Schema for Going to a Restaurant

Scene I: Entering
Customer enters restaurant
Customer looks for table
Customer decides where to sit
Customer goes to table
Customer sits down

Scene 2: Ordering
Customer picks up menu
Customer looks at menu
Customer decides on food
Customer signals waitress
Waitress comes to table
Customer orders food
Waitress goes to cook
Waitress gives food order to cook
Cook prepares food

Scene 3: Eating
Cook gives food to waitress
Waitress brings food to customer
Customer eats food

Scene 4: Exiting
Waitress writes bill
Waitress goes over to customer
Waitress gives bill to customer
Customer gives tip to waitress
Customer goes to cashier
Customer gives money to cashier
Customer leaves restaurant

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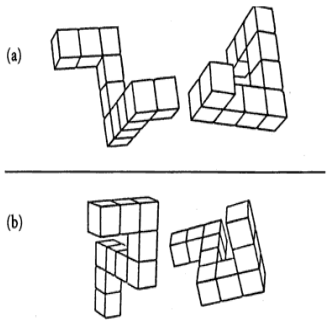

Mental Rotation Test—Are these two figures the same except for their orientation?

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How conscious is thought?

Consciousness should be evaluated on a continuum

Subconscious processes

Mental processes occurring outside of conscious awareness but accessible to consciousness when necessary

Learned behaviors such as **driving**, typing, etc. transition from effortful to automatic processing

Nonconscious processes

Mental processes occurring outside of and not available to consciousness, as in problem solving

(also intuition, beliefs and biases)

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Processing resources

- **Effortful processing** consumes resources (i.e., new tasks).
- **Automatic processes** are fast, reliable, and make fewer demands on resources (i.e., well practiced tasks).

EFFORTFUL ⟷ AUTOMATIC

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Processing varies in consciousness

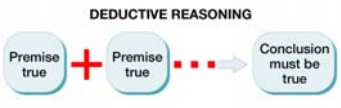
Implicit learning *(versus explicit learning)*
When you have acquired knowledge about something without being aware how you did so, and without being able to state exactly what you have learned
(generally unimpaired by aging, amnesia, and dementia)

Mindlessness
Mental inflexibility, inertia, and obliviousness in the present context
(inadequate attention paid to the task)

Multitasking: *http://www.gocognitive.net/video/david-strayer-driver-distraction-and-cell-phones*

Deductive reasoning

A tool of formal logic in which a conclusion necessarily follows from a set of premises.



All apples are fruit.
All fruits grow on trees.
Therefore all apples grow on trees.

Inductive reasoning

A tool of formal logic in which a conclusion probably follows from a set of premises.

Oranges are fruit and grow on trees
Lemons are fruit and grow on trees
Pears are fruit and grow on trees
It seems reasonable to assume that all fruits might grow on trees.

Deductive vs Inductive Science

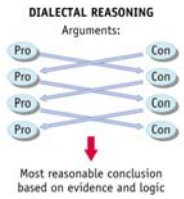
- **Deduction**
  - Top-down approach
  - drawing conclusions from **principles** assumed to be true
  - theory → hypothesis → observation → confirmation *(or not)*
  - Narrowly focused scientific inquiry
- **Induction**
  - Bottom-up approach
  - drawing conclusions based on **evidence**
  - observation → pattern → tentative hypothesis → theory
  - Open-ended and exploratory scientific inquiry

Theory: *Neurological slowing causes age-related cognitive declines.*

Informal Reasoning

Dialectical reasoning
A process in which opposing facts or ideas are weighed and compared, with a view to determining the best solution or resolving differences

Heuristic
A rule of thumb that suggests a course of action or guides problem solving but does not guarantee an optimal solution



Reflective judgment
, aka 'critical thinking'

Requires an ability to recognize and deal with uncertainty, and develops with age and education

Skills
- Question assumptions
- Evaluate and integrate evidence
- Relate evidence to theory or opinion
- Consider alternative interpretations
- Reach defensible conclusions
- Reassess conclusions in face of new evidence

Heuristic Reasoning

- Generate all possible 4-5 letter words using:
  A B M N O R S T
- **Algorithm:** check all possible combinations against a dictionary
- **Possible heuristics:** start with consonants or common word beginnings
- Heuristics are less accurate than formal logic.

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The Availability Heuristic

- When people make estimates of likelihood, their estimates are influenced by the ease with which relevant examples come to mind
- But, the ease with which we remember examples is not perfectly correlated with objective frequency
- Hence, **errors may arise** when using this heuristic

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Availability Heuristic Biases

- Any factor *besides frequency* that calls attention to the event may lead people to overestimate that event's frequency.
- Examples:
  - Emotional response
  - General world knowledge
  - Familiarity
  - Salience and vividness

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Availability Heuristic, e. g.

- Which are there more of
  - Words that start with K, or words that have K as their third letter?
- Most people say "words that start with K" because it's easier to think up examples
- But, there are 3 times as many words with K as the third letter

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Representativeness Heuristic

When people estimate the probability of an event by

a) how similar the event is to the ***population*** of events it came from, or

b) whether the event seems to be similar to the ***process*** that produced it

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- Which outcome is more likely when tossing a coin six times?

H H H T T T T H T T H T

  - Since coin tosses are random processes, most people pick the second outcome because it ***looks random***
  - Using the algorithm, both outcomes are equally likely
- We are also more likely to prefer "random-looking" lotto numbers due to representativeness bias

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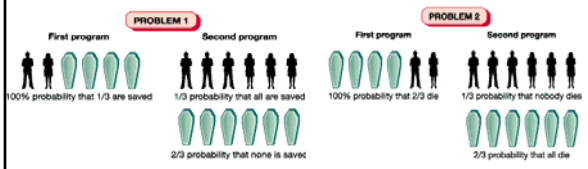
Avoiding loss

People try to minimize risks and losses when making decisions.



* Sure gain

* Avoid loss

We tend to prefer positive frames

- 95% fat-free sounds a lot better than "contains 5% fat."
- Politicians talk about "eliminating welfare handouts" but not about "requiring all citizens to be entirely self-sufficient."
- Pharmaceutical companies claim that medications are 90% effective, not 10% ineffective.

http://cat.xula.edu/thinker/decisions/heuristics/framing

Biases due to mental set

Mental set

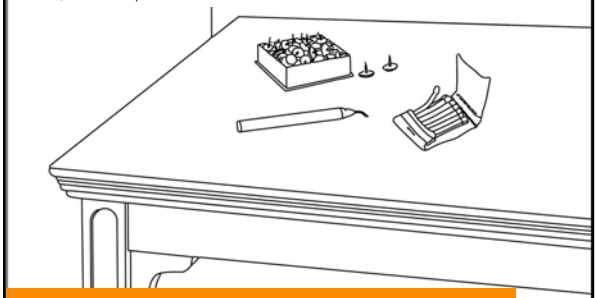
Tendency to solve problems using procedures that worked before on similar problems

Mental sets make learning and problem solving more efficient.

Not helpful when problem calls for new approach

You have:
A candle
A box of nails
A pack of matches

Your goal: Attach the candle to the wall so that, when lit, it does not drip wax on the table below



The candle problem used by Dunker (1945)

The Fairness bias

The *Ultimatum Game*: Your partner gets $10 and must decide how much to share with you. You can accept or reject the offer, but if you reject it, neither of you gets any money.

It is rational to accept any offer: you always end up with more money if you accept than if you reject the offer.

In industrial societies, offers of 50% are typical.

Offers below 20–30% are commonly rejected.

The Hindsight bias

The tendency to overestimate one's ability to have predicted an event once the outcome is known.

The "I knew it all along" phenomenon

* Can be a problem for self-testing learning

The confirmation bias

The tendency to pay attention only to information that confirms one's own beliefs

Test this rule: If a card has a vowel on one side, it has an even number on the other side.

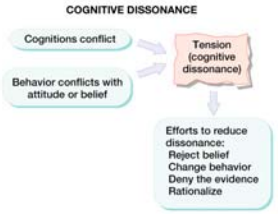
Which 2 cards to turn over?

1. Cards 6 and 7
2. Cards J and 6
3. Cards J and 7
4. Cards E and 6

Need for cognitive consistency

Cognitive dissonance

A state of tension produced when a person holds two contradictory cognitions or when a person's belief is inconsistent with his/her behavior



- *I chose school A. I have to give up all things I liked about school B.*
  - What might I do to reduce the dissonance?
- *I spent my savings for this car. Recent reviews indicate that this car is a lemon.*
  - What can I do to reduce the dissonance?
  - How would it differ if the car were a gift?
- *I think it is wrong to cheat. I cheated.*
  - How might I reduce the dissonance?
  - What are the implications?

Conditions which may lead one to reduce dissonance

When you need to justify a choice or decision you freely made

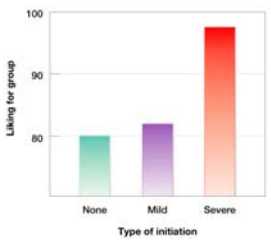
When you need to justify behavior that conflicts with your view of yourself

When you need to justify the effort put into a decision or choice

Justification of effort

The tendency of people to increase their *liking* for something they have worked hard for or suffered to attain

A common form of dissonance reduction



Overcoming cognitive biases

- When people have some expertise in an area
- When decisions have real-life consequences
- When people understand the bias

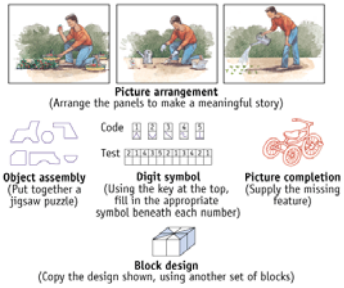
Defining intelligence

Intelligence
An inferred characteristic of an individual, usually defined as the ability to profit from experience, acquire knowledge, think abstractly, act purposefully, or adapt to changes in the environment

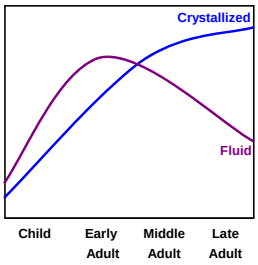
***g* factor**
A general intellectual ability assumed by many theorists to underlie specific mental abilities and talents

Factor analysis
A statistical technique that uses clusters of correlated items to identify basic traits or abilities

Wechsler tests performance tasks



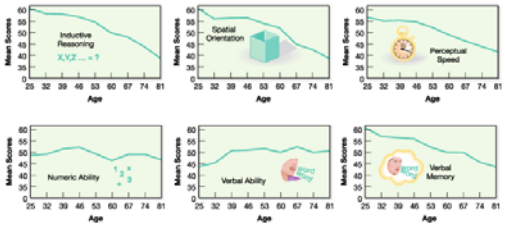
- Fluid intelligence
  - ***biological hardware***
  - measured by speed and accuracy in simple tasks
  - declines with age
- Crystallized intelligence
  - ***cultural software***
  - measured by factual and strategic knowledge
  - increases with age



Lifespan intellectual changes

Some intellectual abilities dwindle with age.

Numerical and verbal abilities relatively stable.



The invention of IQ tests

Psychometrics **is the measurement of mental abilities, traits, and processes**

Binet believed we should measure a child's *mental age* and developed a test which measured memory, vocabulary, and perceptual discrimination.

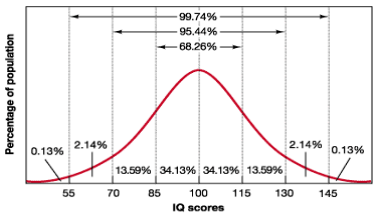
Mental age was divided by chronological age and multiplied by 100 to get an *intelligence quotient*.

Now IQ scores are derived from norms provided for standardized intelligence tests.

The psychometric approach

IQ scores distributed normally: Bell-shaped curve

Very high and very low scores are rare. 68% of people have IQ scores between 85 and 115. 99.7% between 55 and 145



Expectations and IQ

Scores are affected by expectations for performance

Expectations are shaped by stereotypes

Stereotype threat

Burden of doubt one feels about his/her performance due to negative stereotypes about his/her group

Stereotype threat affects African-Americans, Latinos/Latinas, low-income people, women, and the elderly.

Stereotype threat

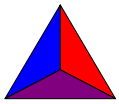
Information-processing approach

Sternberg's triarchic theory

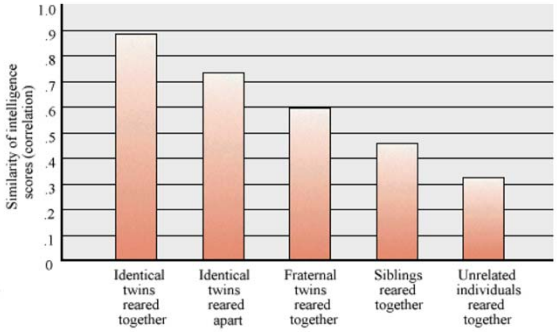
Componential (analytic)
Comparing, analyzing, and evaluating
This type of process correlates best with IQ

Experiential (creative)
Inventing solution to new problems
Transfer skills to new situations

Contextual (practical)
Applying the things you know to everyday contexts



Gardener's Multiple Intelligences



Origins of Intelligence

- Intelligence is highly heritable, but is also strongly impacted by environmental factors such as:
  - Prenatal care
  - Nutrition
  - Pollutant exposure
  - Family circumstances
- Also note that internal characteristics (*such as self-discipline*) have a larger impact on measures of success (like grades) compared to IQ

Animal intelligence

Cognitive ethology
The study of cognitive processes in non-human animals

Studies show that animals can
Anticipate future events
Use numbers to label quantities
Coordinate activities with other animals

Animals and language

Language is a critical element in human cognition.

Many species can be taught to communicate in ways that resemble language.

Chimpanzees and bonobos converse using American Sign Language and symbol board systems.

An African grey parrot has been taught to count, classify, and compare objects using English words.

Whether these behaviors are language depends on definition of "language."