

# Chapter 7

Cognition: Thinking, Intelligence  
& Language

# What is This?

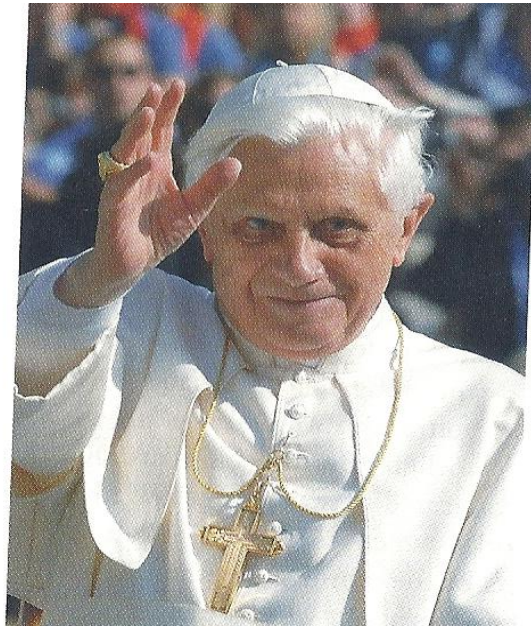
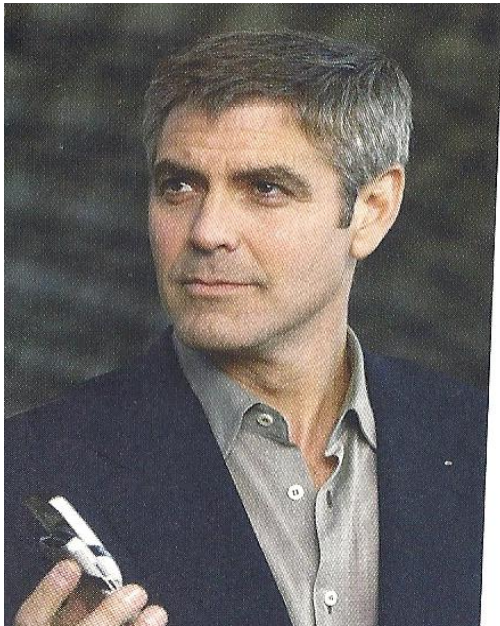


# Elements of Cognition

- **Concept** – ideas that represent a class or category of objects, events, or activities.
  - Dog = golden retriever, collie, St. Bernard, Pomeranian
  - Emotion = happy, sad, fear, excitement
  - You know what they are even if not first hand experience
- **Basic concepts** have a moderate number of instances and that are easier to acquire than those having few or many instances.
  - Apple more basic than fruit, less specific than Macintosh apple
  - Book more basic than printed material
- **Prototype** – an especially representative example of a concept
  - To decide if item belongs to a concept we compare it to a prototype
  - not all dogs bark, not all apples are red, not all birds fly
    - Which dog is doggier; a golden retriever or a Chihuahua?
    - Which fruit is fruitier; apple or pineapple?
  - *Prototypical* – most representative



# Which is a Prototypical Bachelor?

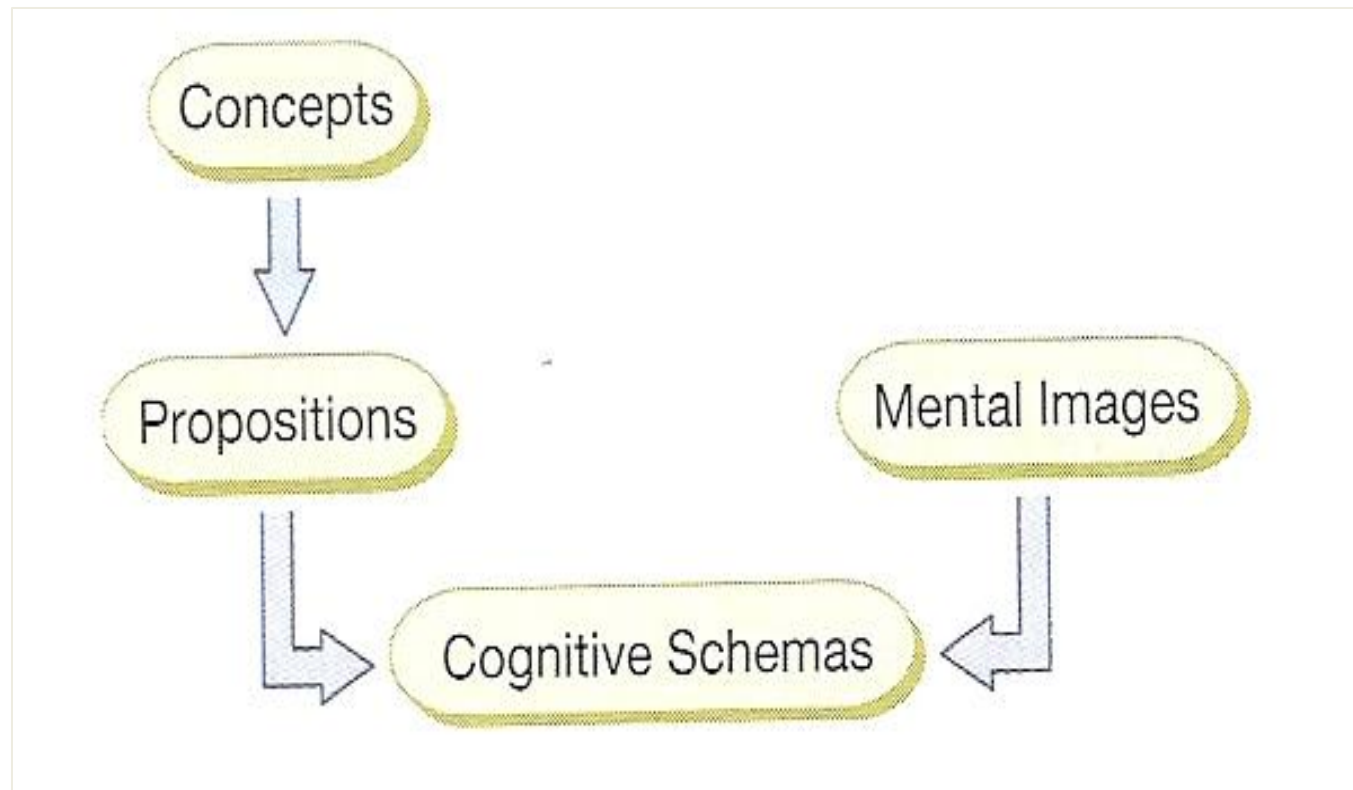




# Elements of Cognition

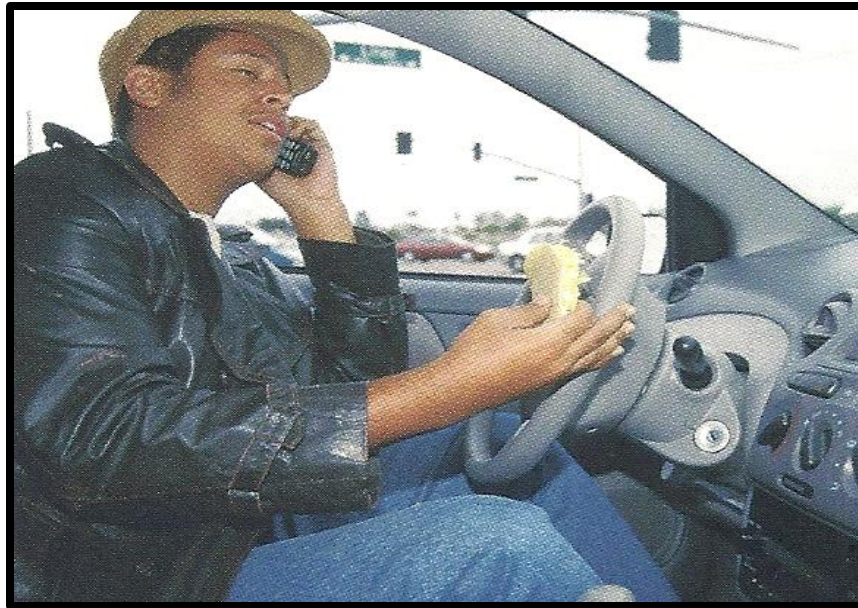
- **Proposition** –unit of meaning that is made up of concepts and expresses a single idea (relationship to another)
  - Students study General Psychology
  - Student like General Psychology
- **Cognitive schema** – integrated mental network of knowledge, beliefs & expectation concerning a particular topic or aspect of the world
  - Mental model of world
  - Gender schema regarding beliefs about what it means to be male or female
  - Schemas regarding – culture, occupations, geographical locations
- **Mental image** – mental representations that mirrors or resembles the thing it represents; mental images occur in many (if not all) sensory modalities.
  - visual images; picture in mind's eye
  - Auditory – in mind's ear – song; slogan
  - Important in thinking and in construction of cognitive schemas

# Elements of Cognition



# How Conscious is Thought?

- **Subconscious process** – mental processes occurring outside of conscious awareness but accessible to consciousness when necessary
  - Eat and read a book
  - Drive and listen to music
  - Multitasking – takes longer; less efficient / accurate
    - study and listen to music or TV = less effective



# How Conscious is Thought?

- **Non-subconscious process** – Mental processes occurring outside of and not available to conscious awareness.
  - Not know answer at test time then think of it as walking out the door
  - Intuition; hunches & gut feelings
  
- **Implicit learning** – learning that occurs when you acquire knowledge about something w/o being aware of how you did & w/o being able to state exactly what it is you have learned
  - Strategy to win a game
  - How to speak native language
  - Walk up stairs



# How Conscious is Thought?

- **Mindlessness** may be thinking but not vary hard
  - Act, speak & make decisions out of habit w/o stopping to analyze
  - Worker at Mc Donald's gave change for \$200 bill



# Quick Quiz

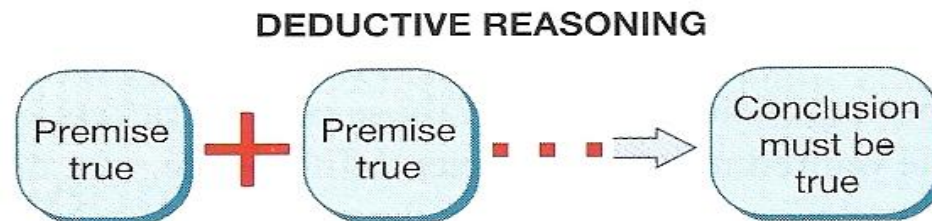
- 1) Which concept is most basic; *furniture, chair or high chair*?
- 2) Which sample of the concept chair is prototypical:  
*High chair; rocking chair; dining room chair*
- 3) In addition to concepts & images, \_\_\_\_\_ which express a unitary idea, may be a basic form of mental representation.
- 4) Paul's mental representation of Thanksgiving included associations (turkey); attitudes (It's time to be with relatives); and expectations (I'm going to gain weight from all that food"). They are all part of his \_\_\_\_\_ for the holiday.
- 5) Karen discovers that she has called her boyfriend Mike's phone number instead of her mother's as she intended. Her error can be attributed to \_\_\_\_\_ .

## Word bank for questions 3, 4 & 5

cognitive schema; mindlessness; proposition; subconscious process

# Formal Reasoning

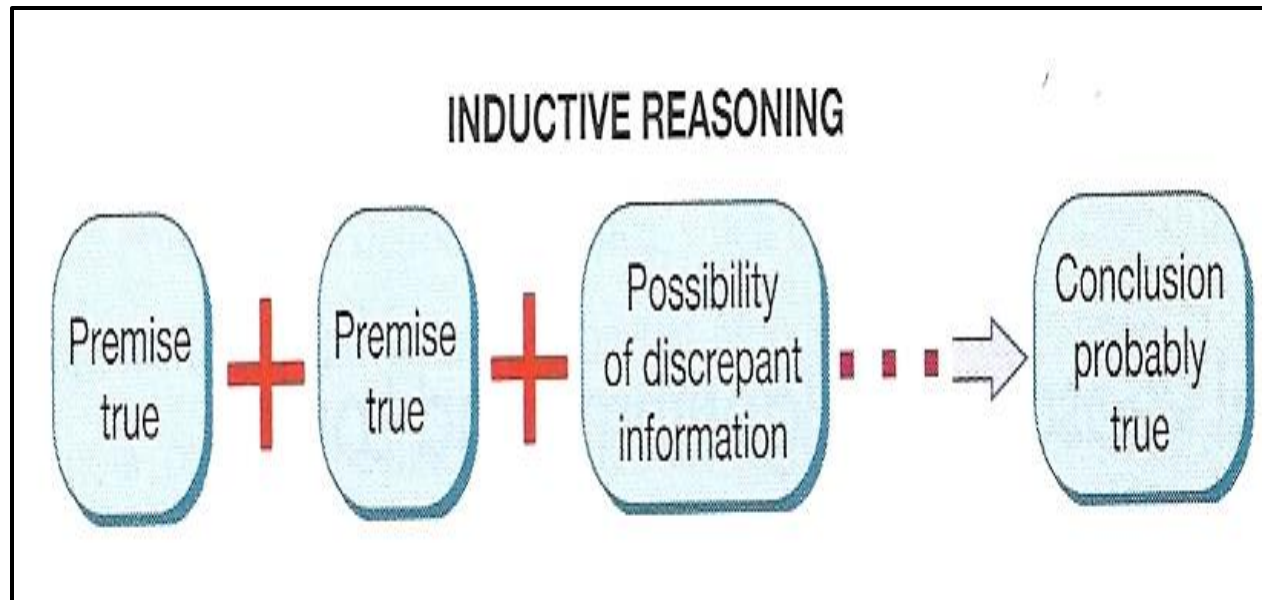
- **Formal Reasoning** – IQ test; college entrance exam;
- **Reasoning** - Drawing conclusions or inferences from observations, facts, or assumptions
- **Algorithm** – a problem solving strategy guaranteed to produce a solution even if the user does not know how it works
  - Long division
- **Deductive Reasoning** – a form of reasoning; conclusions follow certain premises; if the premises are true = conclusion must be true.
  - Psych 1000 meets MWF at 7:00am; it's Monday; I need to be at class
  - Sherlock Holmes

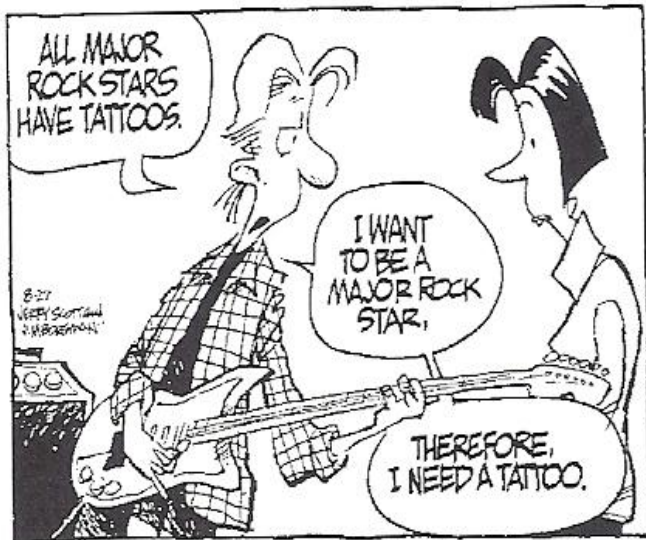


- Errors possible:
  - All rapists are men = All men are rapists

# Formal Reasoning

- **Inductive reasoning** – a form of reasoning; the premises provide support for conclusion but possible for the conclusion to be false
  - I've eaten at Mi Margarita several times; they have good food
    - Food likely good but could have been just what you ordered
  - Something is probably true
  - Science depends on inductive reasoning
    - observation = draw conclusion

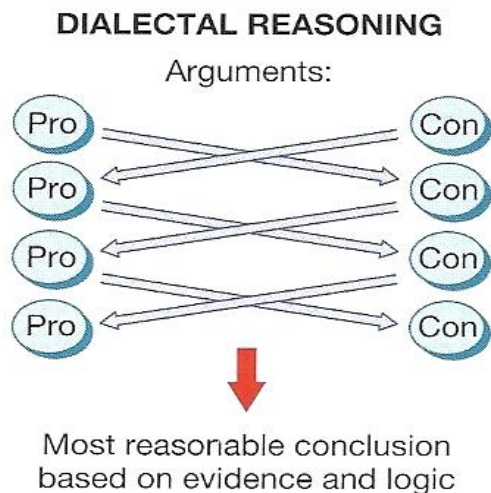






# Informal Reasoning

- **Informal reasoning** - No clear correct answer; lack of information
  - Abortion; Death penalty; Going to war; increase taxes
- **Heuristic** – a rule of thumb; suggests a course of action / guides problems solving but does not guarantee an optimal solution
  - Moves to make in a chess game
  - Strategy to play card game
- **Dialectal Reasoning** opposing facts or ideas are weighted & compared, to determine the best solution or solving differences.



= listens to both sides; weighs evidence = decide

# Problem Solving

- **Trial and Error** – one possible solution tried after another.
- **Algorithms** – specific, step-by-step procedures for specific problem
- **Heuristic** – an educated guess based on prior experiences that narrow down the possible solutions for a problem  
“rule of thumb”
  - **Representative Heuristic** – any object sharing characteristics = member
  - **Availability heuristic** – frequency or likelihood based on ease to recall info
  - **Means-end- analysis**- look at difference in begin & end; steps to reduce dif.
- **Insight** – “aha moment”; solution in a flash.....“magic”  
information reorganizes a problem = solution
  - think outside the box

# Critical Thinking

- **Critical thinking** – question assumptions; evaluate and integrate evidence; consider alternatives and reach conclusions that can be defended as most reasonable.
- Adults & adolescents were given opposing statements then asked:
  - What do you think about these statements?
  - How did you come to hold that point of view?
  - On what do you base your position?
  - Can you ever know for sure that your position is correct?
  - Why do you suppose disagreement exists about this issue?

# Creativity

Solving problems by combining ideas or behaviors in new ways

- Steve Jobs – Apple
- Convergent thinking – 1 problem = 1 solution
- Divergent thinking – 1 problem = many solutions
  - Brainstorming – many ideas practical or not
  - Keeping a journal- list of ideas
  - Free writing – write everything – edit later
  - Mind or subject mapping- visual representation concepts and connections

# Quick Quiz

- Most of the Christmas gifts Kevin bought this year cost more than they did last year, so he concluded that inflation is increasing. What kind of reasoning: Inductive, deductive, dialectical?
- Jane is arguing with Pam about whether real estate is a better investment than stocks. “You can’t convince me,” says Jane. “I just know I’m right: Jane needs training in \_\_\_\_\_ reasoning.
- Joe thinks the media have a liberal political bias, and Sue thinks they are too conservative. “Well,” says Joe, “I have my truth & you have yours. It’s purely subjective”. What level of thinking?
- What evidence might resolve this issue between Joe and Sue?



# Barriers to Rational Reasoning

- Exaggerating the Improbable (minimizing the probable)
- **Affect heuristic** – tendency to consult one's emotions instead of estimating probabilities of objective
  - Mad cow disease vs. bovine spongiform encephalopathy =beef sales
- **Availability heuristic** – tendency to judge the probability of a type of event by how easy it is to think of examples or instances
  - Works with affect heuristic
  - More available mental picture = more likely to use that example
    - Tornados exaggerated; asthma under estimated
    - 911 – fear flying so drive even though 65 x more dangerous
  - Jaws & shark attacks

# Barriers to Rational Reasoning

## Avoiding Loss - Minimize risks

- Which program would you enter?
  - 1) Will definitely save 200 people
  - 2) 1/3 probability of saving all 600 people & 2/3 probability of saving none
    - Most pick program 1
- Which program?
  - 1) 400 definitely die
  - 2) 1/3 probability of nobody dying & 2/3 probability that all 600 will die
    - Most chose program 2
- Reject risk when they think of the outcome as lives saved; but Accept risk when they think of the outcome as lives lost

# Avoiding Loss

## PROBLEM 1

First program



100% probability that 1/3 are saved

Second program



1/3 probability that all are saved



2/3 probability that nobody is saved

## PROBLEM 2

First program



100% probability that 2/3 die

Second program



1/3 probability that nobody dies



2/3 probability that all die

# Barriers to Rational Reasoning

- **Fairness Bias** – usually motivated to avoid loss yet.....
- **Ultimatum Game** –
  - 2 people
  - partner gets \$10 and decide how much to give you
  - If you accept; both keep the money
  - If you reject the offer; no one gets money
  - reject even though anything is better than nothing
- **Monkeys** – give token to get a slice of cucumber
  - Saw in next cage that other monkeys were give a grape
  - Stopped giving the token = got nothing
  - Even through down their cucumber slice

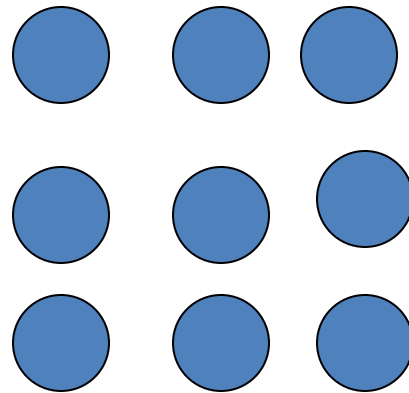


# Barriers to Rational Reasoning

- **Hindsight bias** – to over estimate one’s ability to have predicted an event once the outcome is known.
  - “I knew it all along” phenomenon.
  - I knew they would break up
- **Confirmation Bias**-tendency to pay attention only to information that supports one’s beliefs
  - People are rarely excited to hear news that is contrary to their beliefs
  - Pay more attention to those that confirm
- **Mental Sets** – Try to solve new problems using same heuristics, strategies and rules that worked in the past.
  - Trying to find patterns to events



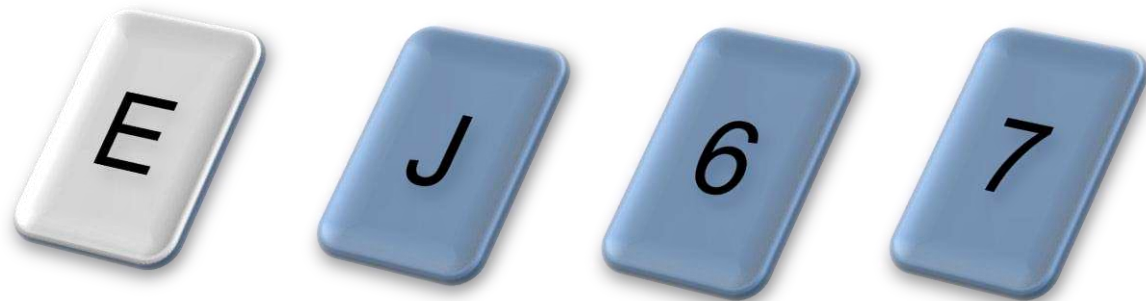
- Connect the dots with 4 straight lines
- Pen can not leave the paper



Is the following rule true?

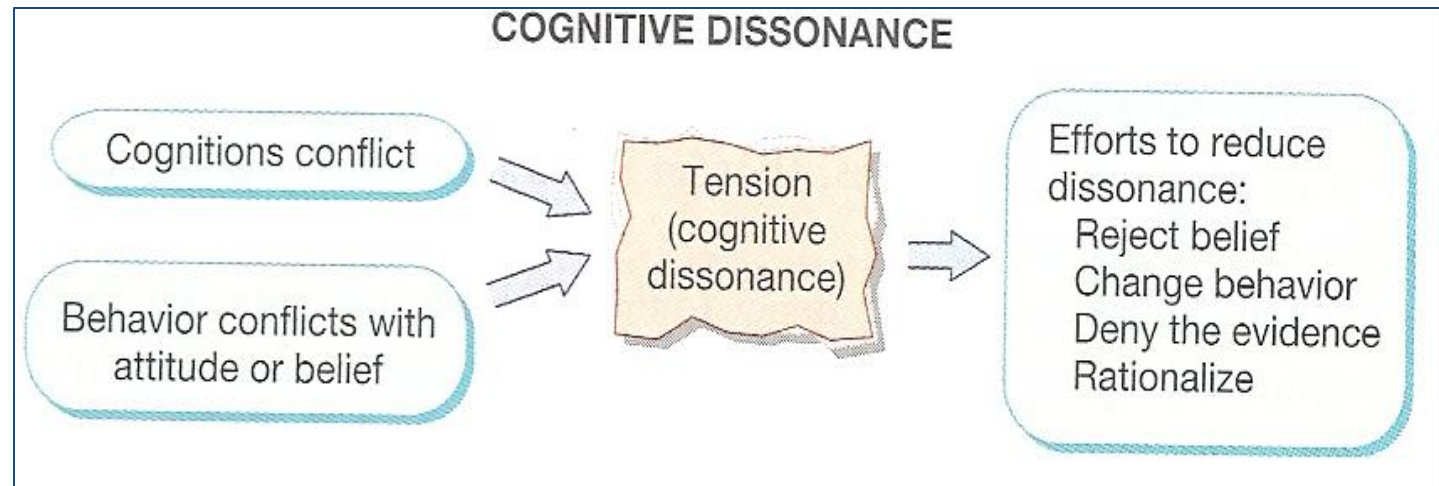
- If a card has a vowel on one side, then
- it has an even number on the other side

Which 2 cards do you need to turn over to find out?



# Need for Cognitive Consistency

- **Cognitive dissonance** – a state of tension when a person holds 2 cognition that are psychologically inconsistent or when a person’s belief is incongruent with their behavior.
  - Dissonance – opposite of consistency



# Cognitive Dissonance

- How do people react to failed prophecies?
  - People thought world was to end on 12/20
  - Believers would be whisked away to safety
  - Some quit their jobs; spent their life savings
    - Those that made no public commitment:
      - lost faith
    - Those who sold all:
      - increase belief to avoid dissonance
  - Leader stated:
    - “world saved because of group’s strong belief”



# 3 Situations That Cause Dissonance

- 1) To justify a choice or decision you made freely
  - Buyers remorse
  - **Post-decision dissonance** – Think you may have made a bad choice
    - If you choose car - “I love my car even if it is in the shop every month”
    - If someone else chose no dissonance
  
- 2) To justify behavior that conflicts with your view of self
  - Feel you are honest but choose to cheat
    - “everyone does it”
    - “it’s just this once”
  
- 3) To justify the effort put into a decision or choice
  - More you work = more value goal
  - **Justification of effort** – increase their liking for something that they have worked hard or suffered to obtain; a common form of dissonance reduction

# Quick Quiz

- 1) In 2001, an unknown person sent anthrax through the US post office. Many people became afraid to open their mail, although the risk for any given individual was extremely small (5 people died during the attacks). What heuristic explains this?
- 2) Research on the Ultimatum Games shows that people usually act out of rational self-interest. True or False?
- 3) Bill meets a young woman in the cafeteria. They hit it off and eventually get married. Bill says, "I knew that day that something special was about to happen." What cognitive bias is affecting his thinking?
- 4) You are part of an experiment that is boring and repetitive; you must tell other students about to participate that it was fun & interesting. Half got \$1 and the other half got \$20. Which group decided that the study had been fun after all & why?

# Intelligence

- **Intelligence** –
  - usually defined as ability to profit from experience
  - acquire knowledge
  - think abstractly
  - act purposely
  - adapt to changes in the environment.
- **Factor Analysis** –
  - a statistical method for analyzing the inter-correlations among
  - various measures or test scores;
  - clusters of measures or scores that are highly correlated are
  - assumed to measure the same underlying trait, ability or aptitude (factor)
- **Psychometrics** – measurement of mental abilities, traits & processes

# Types of Intelligence

- **Speaerman**
  - **G-Factor** – ability to reason & solve problems, or general intelligence
  - **S-Factor** – excel in certain areas, or specific intelligence
- **Garnder's Multiple Intelligences** – (not just logic, reason & knowledge)
  - 1) Verbal/linguistic
  - 2) Musical
  - 3) Logic / mathematical
  - 4) Visual / spatial
  - 5) Movement
  - 6) Interpersonal
  - 7) Intrapersonal
  - 8) Naturalistic
  - 9) Existentialist



# Theories of Intelligence

## Sternberg's Triarchic Theory

- information – processing strategies
  - the ability to creatively transfer skills to new situations
  - the practical application of intelligence.
- Skills & knowledge needed for success in life according to self

## 3 Aspects

### 1) Analytical Intelligence –

- Problem solving; break down into components, parts for analysis
  - Recognize and defining the problem
  - Selecting a strategy for solving
  - Mastering strategy
  - Carrying out the strategy and evaluation of results
- Metacognition – knowledge or awareness of own cognitive process and abilities to monitor and control those processes
  - too much time studying on what they know
  - not enough time at what they don't

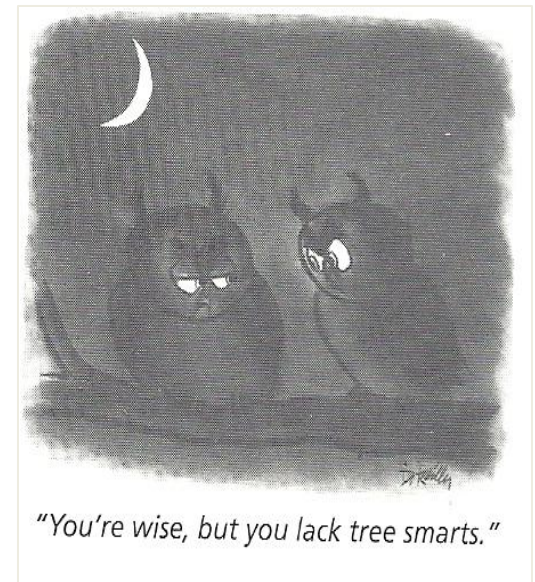
# Triarchaic Theory

## 2) Creative (experiential) intelligence –

- Creativity in transferring skills to new situation
  - Cope with novelty
  - Learn quickly to make a new task automatic
  - If not have this:
    - Great at meeting due dates are specified and immediate response
    - Problems w/ self imposed deadlines at work & employer not tell how doing

## 3) Practical (contextual) intelligence –

- Practical application of knowledge; adjust for different context
  - Able to adapt to different environments
- **Tacit knowledge** – practical action oriented strategies for achieving goals not formally taught or verbalized; inferred

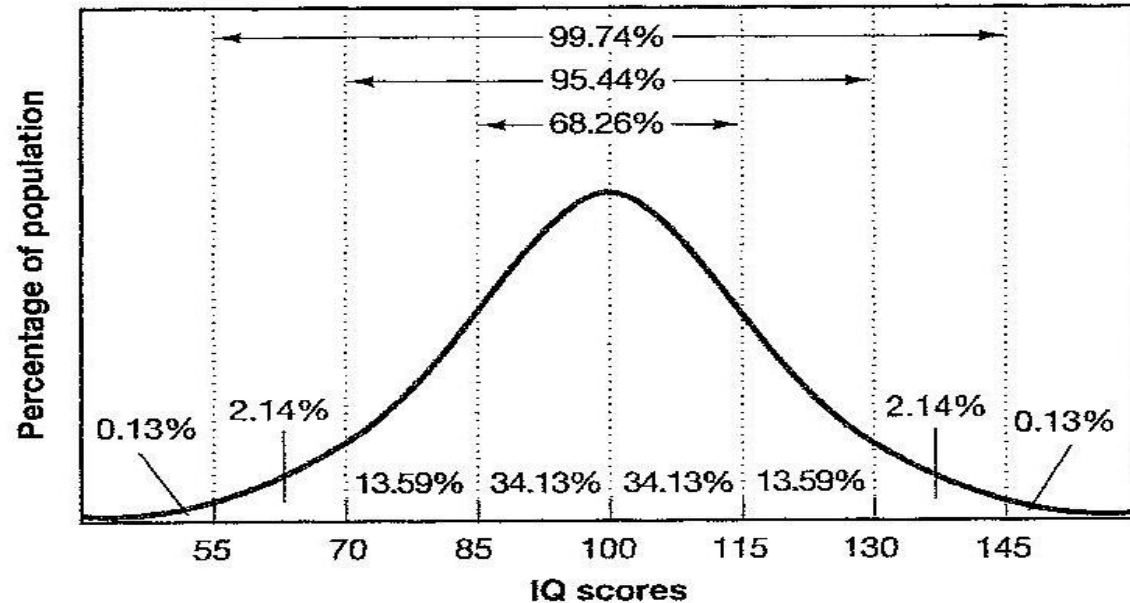


# Intelligence

Binet's Brainstorm (France) –

- Why do some children answer like those younger and other like those older?
- **Mental age (MA)** – measure of mental development expressed in terms of the avg mental ability at a given age.
- **Intelligence quotient (IQ)** – a measure of intelligence originally computed by dividing a person's mental age by their chronological age and multiply by 100; now from norms provided form standardized intelligence tests.
- Why change formulation?
  - 8 yr old perform like 10 yr old (mental age) = IQ 125 (10 divided by 8 X 100)
  - All average children, regardless of age would have an IQ of 100
  - Did not explain adults a 50 year old who scores like a 30 year old not low IQ

# Distribution of IQ Scores



**FIGURE 9.3 Expected Distribution of IQ Scores**

In a large population, IQ scores tend to be distributed on a normal (bell-shaped) curve. On most tests, about 68 percent of all people will score between 85 and 115; about 95 percent will score between 70 and 130, and about 99.7 percent will score between 55 and 145. In any actual sample, however, the distribution will depart somewhat from the theoretical ideal.

# Intelligence

- Lewis Terman (Stanford University)
  - Normed for US
  - Stanford – Binet Intelligence Scale 1916
- David Wechsler 2 tests (20 years later)
  - Wechsler Adult Intelligence Scale (WAIS)
  - Wechsler Intelligence Scale for Children (WISC)
- Verbal
  - Vocabulary
  - arithmetic abilities
  - immediate memory span
  - recognize similarities
  - general knowledge
  - comprehension
- Performance
  - Ability to recreate block design within specified time limit
  - Id missing part from picture
- General IQ plus 4 subsets
  - Verbal comprehension
  - perceptual reasoning
  - working memory
  - processing speed

# WAIS



**Picture arrangement**

(Arrange the panels to make a meaningful story)



**Object assembly**  
(Put together a jigsaw puzzle)

Code 

1	2	3	4	5
△	▽	◊	⋈	⊥

Test 

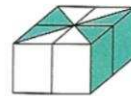
2	1	4	3	5	2	1	3	4	2	1

**Digit symbol**

(Using the key at the top, fill in the appropriate symbol beneath each number)



**Picture completion**  
(Supply the missing feature)



**Block design**

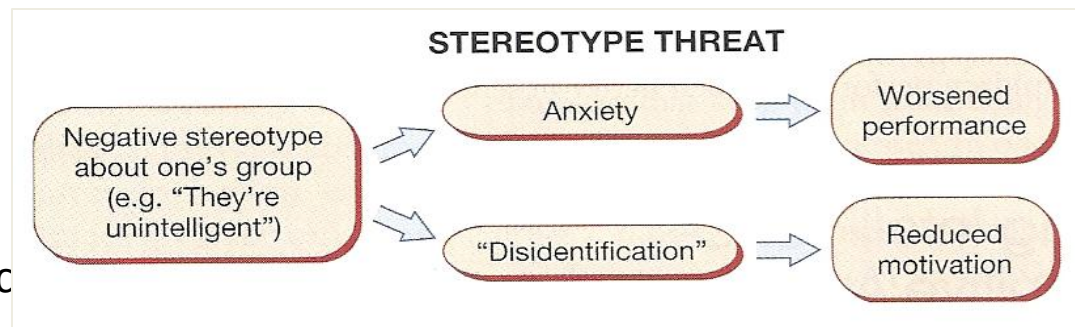
(Copy the design shown, using another set of blocks)

# Culture & Testing

Test not always sensitive to culture

- City over rural
- Middle – class over poor
- White over nonwhite
- Male over female
- Youth over elderly

- **Stereotype threat** - a burden of doubt a person feels about their performance, due to negative stereotypes about their group's abilities.
  - Increased Anxiety = worse performance
    - I hate tests
    - I am no good at math
  - Disidentifying = reduced motivation
    - This test has nothing to do with how I feel about myself



- Adj. for c

support)

# Domains of Intelligence

- What about these situations?
  - Nobel Peace prize winner in medicine not able to budget
  - Autism – Savant syndrome
    - Rainman
  - Traumatic Brain Injury –
    - Lose one domain not another
- **Emotional intelligence (EQ)** – ability to ID your own and other people's emotions accurately, express your emotions clearly and regulate emotions in yourself and others.
  - If not able to ID own behavior
    - Not able to cope to tragedy
    - Express emotions inappropriately
  - If not able to ID in others
    - Poor work and friend relationships
    - Miss read verbal cues or body signs



# Psychometric & Cognitive

## Psychometric

### Focus

*Performance on standard tests*

### What is intelligence

*A general intellectual ability captured by IQ score; or a range on specific verbal and nonverbal abilities*

### Use Emotional intelligence?

*No*

### Use Practical intelligence?

*No*

### Use well validated standardized tests?

*Yes*

## Cognitive

### Focus

*Strategies used when solving problems*

### What is intelligence –

*Many different skills and talent in addition to intellectual ones*

### Use Emotional intelligence?

*Yes*

### Use Practical intelligence?

*Yes*

### Use well validated standardized tests?

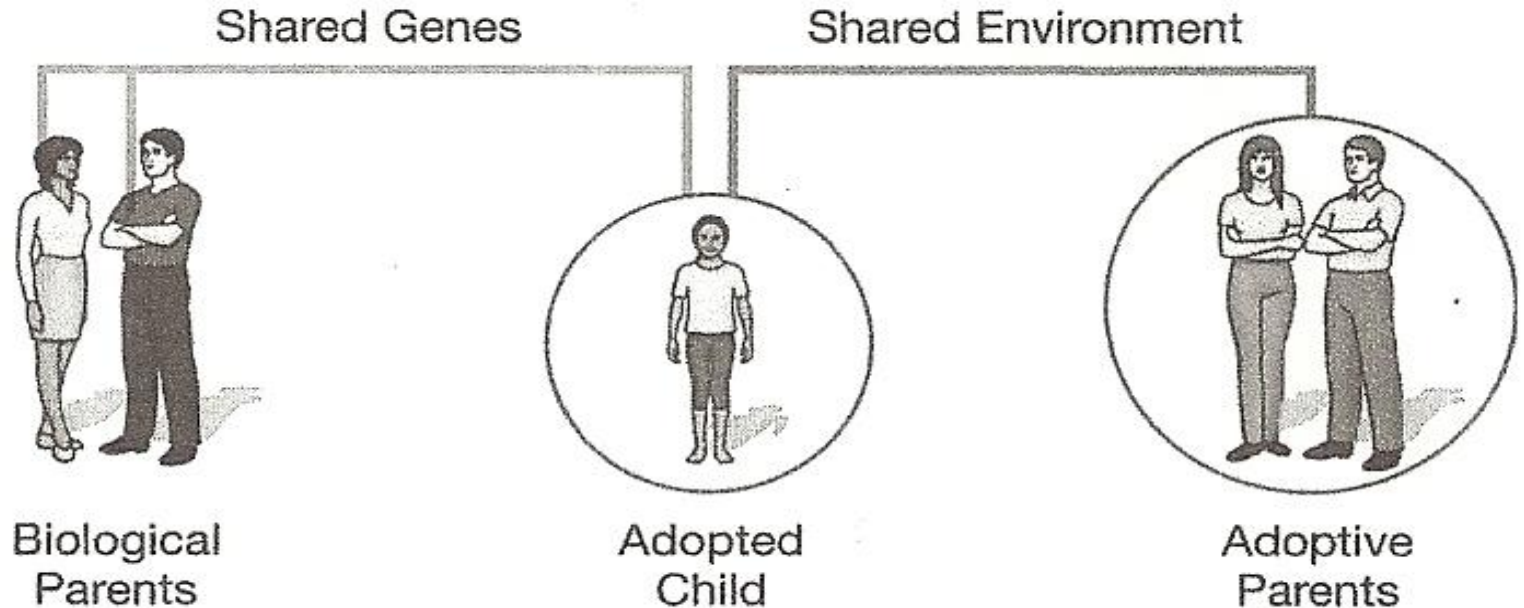
*Being developed*

# Heritability

- Differences: are they genetic, or result of experience and environment?
- Heritability – statistical estimate  
(of the portion of the total variance)  
in some trait that is attributable to genetic  
differences among individuals within a group.
  - Height – highly heritable
  - Table manners – low heritability, more upbringing

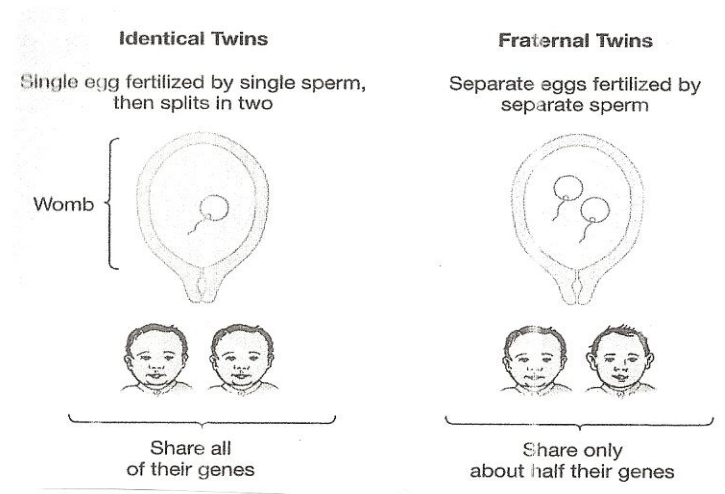
# Heritability

- Adopted children - share genes from each bio. parent (biology)  
raised by adoptive parent (environment)  
compare correlation btw traits of bio & adopted



# Heritability

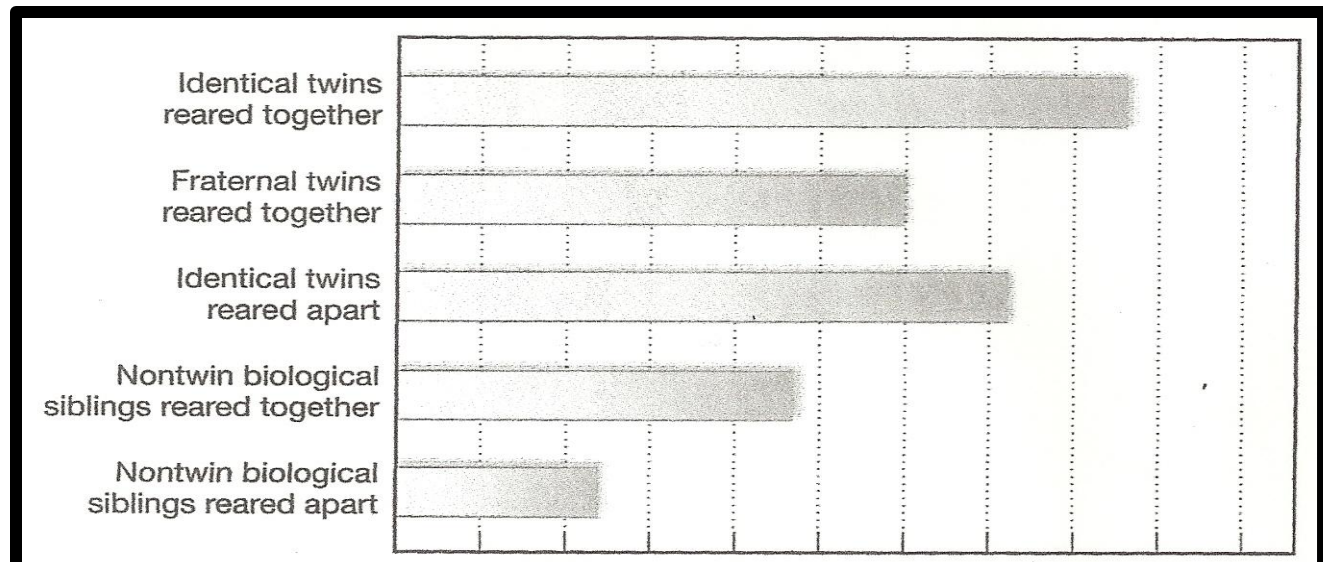
- Identical twins (monozygotic)
  - 1 egg fertilized by 1 sperm
  - Fertilized egg (zygote) – divides into 2 parts = 2 separate embryos
  - Same egg = same genes
  - Same sex



- Fraternal twins (dizygotic)
  - 2 eggs fertilized by 2 sperm
  - Womb-mates
  - No more genetically alike than w/ other siblings
  - Same or different sex
- So..... Why study identical twins?
  - study identical twins living with biological parents
  - study identical twins living with adoptive parents

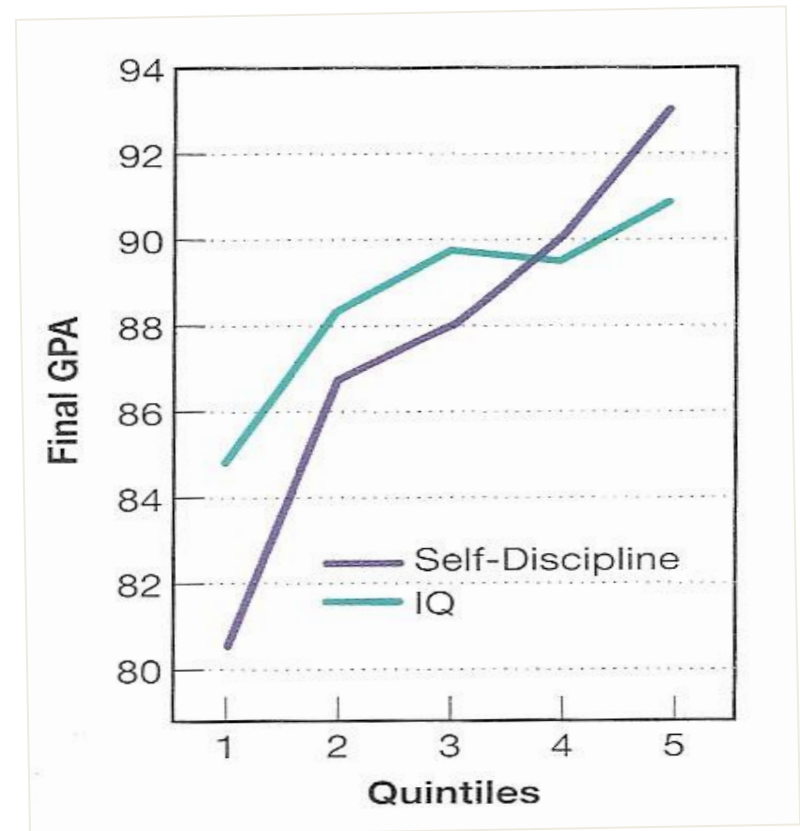
# Genes and Individual Intelligence

- IQ (intelligence quotient) – norms from standardized tests
  - average score of 100 set
  - 2/3 fall between 85-115
  - 15 points +/- 100
- Most think IQ measures a general quality; affects most aspects mental ability
- Some believe culturally bias (middle class; white)
- IQ = highly heritable



# Grades, IQ and Self-Discipline

- Duckworth and Seligman (2005) - 8<sup>th</sup> graders
  - Which is a better predictor of academic performance among adolescents, IQ or self-discipline?
  - Longitudinal study
  - Self report
  - Teacher's report
  - Parent's report
  - Questionnaires
- Self-discipline 2 x's
  - 5 groups

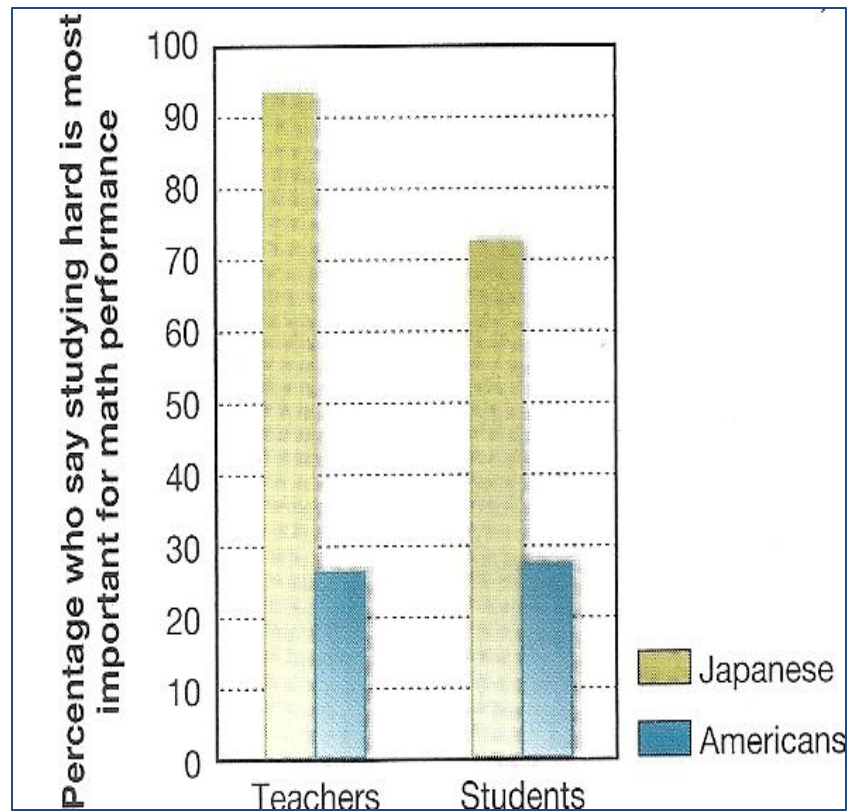


# Culture

## Asians and Americans

- Beliefs about intelligence
  - Americans = math in innate
  - If have ability don't need to work hard
  - If you don't have it, no use in trying
- Standard
  - American parents= lower standards
  - American parents happy with barely average
  - Asian parents only happy with high score
- Values
  - Americans do not value education as much as Asians
  - Ask 5<sup>th</sup> graders, "If wizard could give you anything you wanted"
    - 60% Asians stated something related to academics
    - Americans = money or possessions

# Got it or you Don't?



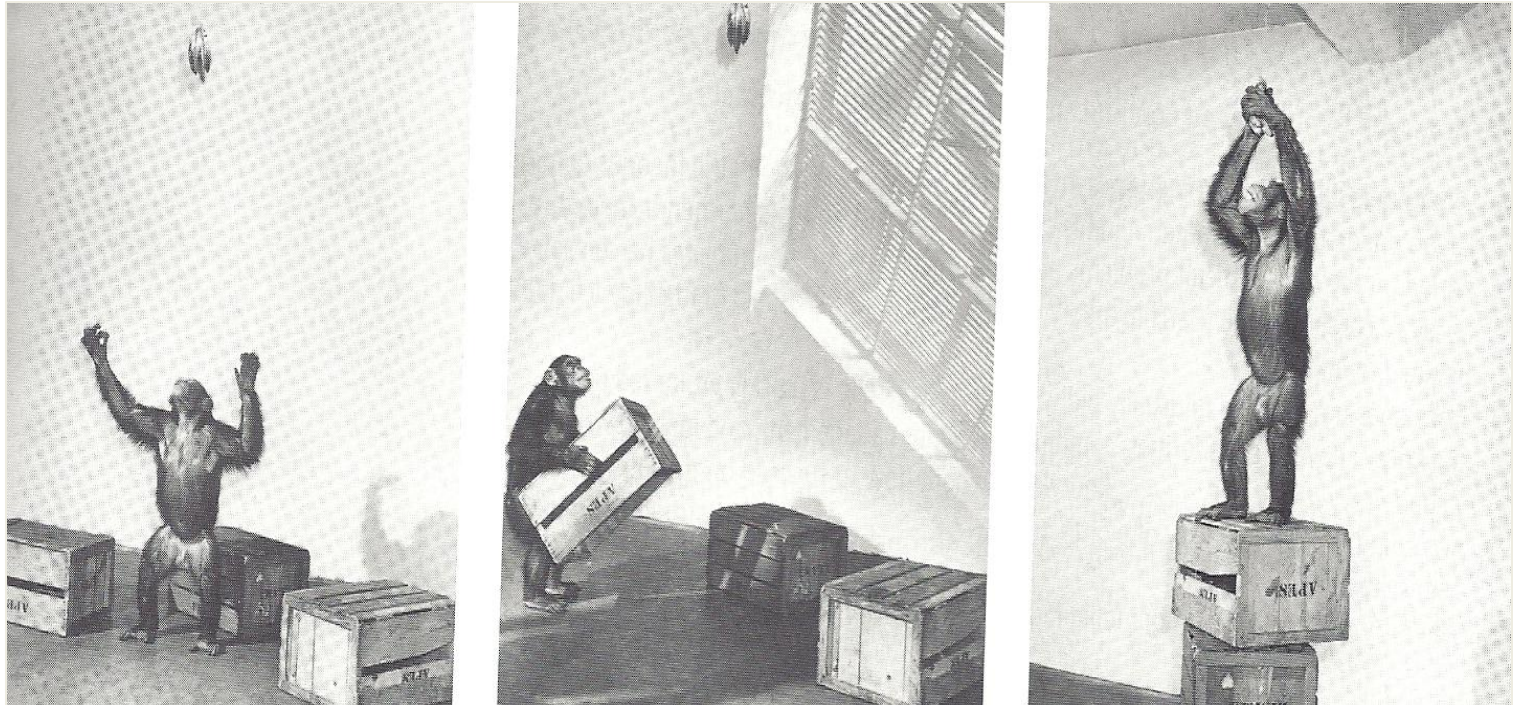


# Quick Quiz

1. What goals do cognitive theories of intelligence have that psychometric theories do not?
2. Logan understands the material in his statistics class, but on tests he spends the entire period on the most difficult problems and never even gets to the problems he can solve easily. According to the triarchic theory of intelligence, which aspect of intelligence does he need to improve?
3. Tracy does not have an unusually high IQ, but at work she is quickly promoted because she knows how to set priorities, communicate with management, and make others feel valued. Tracy has \_\_\_\_\_ knowledge about how to succeed on the job.
4. According to a recent study of 8<sup>th</sup> graders, \_\_\_\_\_ is more strongly correlated with school performance than \_\_\_\_\_ is.
5. What is wrong with defining intelligence as “whatever intelligence tests measure”?

# Animal Intelligence

- **Cognitive ethology** -
  - Study of cognitive process in nonhuman animals
  - Some can anticipate future events
  - Make plans
  - Coordinate their activities with comrades



# Primate Studies

- Able to use objects and simple tools
- Summing of quantities
- Use of symbols to make request
- Understand short English sentences
- Is it Language? Must have these:
  1. Use combinations of sound, gestures or symbols that are meaningful; not random
  2. It must permit displacement – communication about object & event not present (displaced in time or space). Not just pointing at things
  3. Grammar (syntax) that permit productivity – ability to produce and comprehend an infinite number of new utterances.
- By this criteria animals have communication **not** language

# Do Animals Have This?

- **Theory of Mind** –

system of beliefs about way one's own mind and the minds of others work and of how individual are affected by their beliefs and feelings

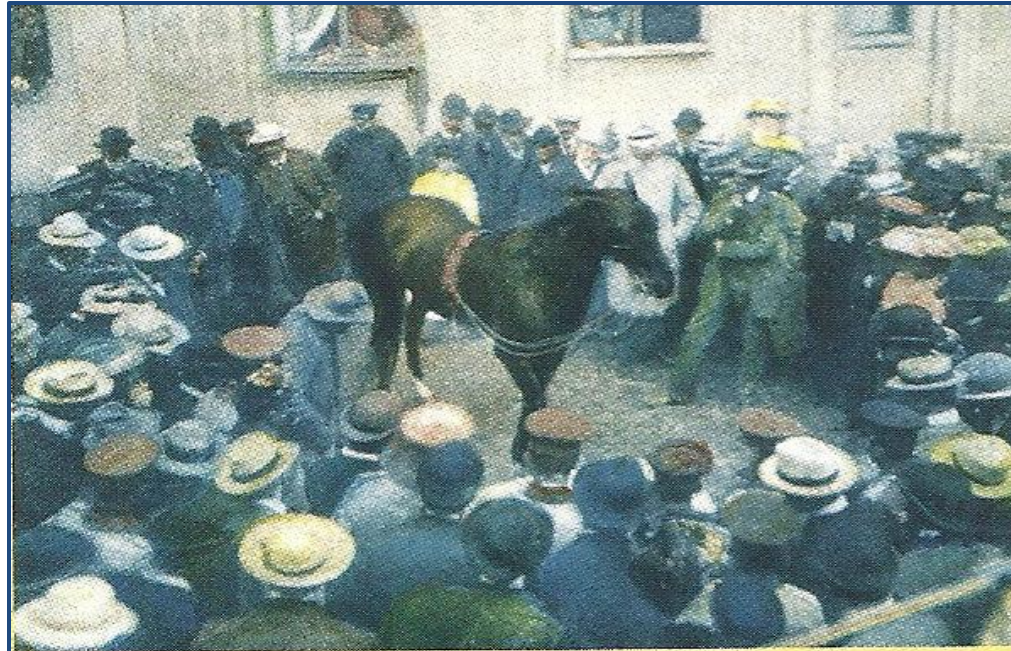
- Great Apes – chimpanzees, gorillas and orangutans?
- Elephants, dolphins ?





# Anthropomorphism

- To falsely attribute human qualities to non-human being.
  - Clever Hans the wonder horse
    - able to do math



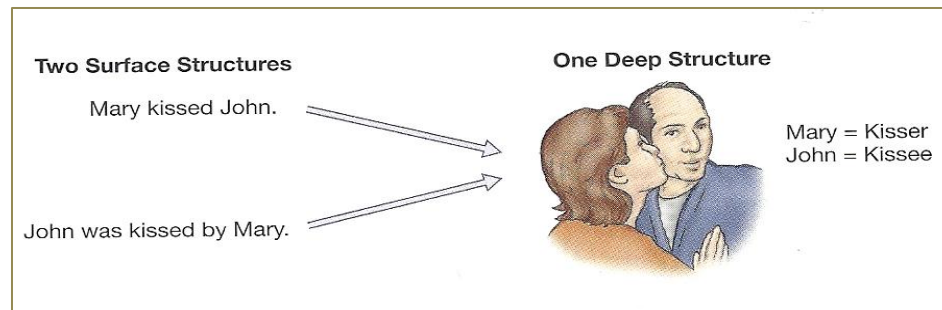
This old photo shows Clever Hans in action. His story has taught researchers to beware of anthropomorphism when they interpret findings on animal cognition.

# Language\*

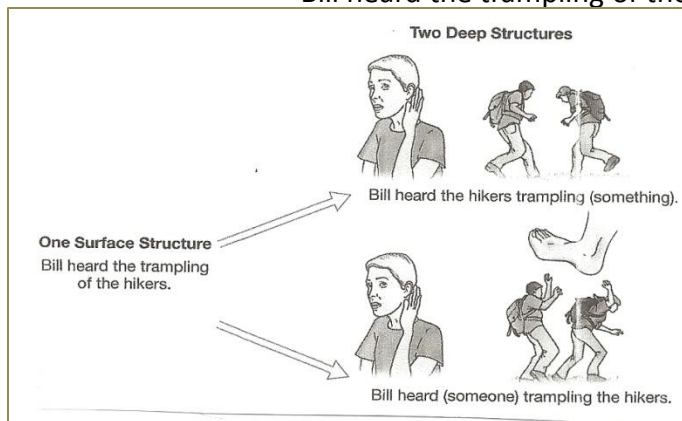
- Language – system that combines meaningless elements; sound & gestures to form structured utterances; convey meaning.
  - Humans
    - Not just speech
    - sign language
    - The ability to create an infinite number of new utterances
  - Non-humans
    - grunts & screeches
    - communicate with each other, but not a language
- The innate capacity for language?
- Language structures
  - Surface structures – how it is spoken or signed
  - Deep structures - what is inferred - how the sentence is to be understood

# Language

- Complex (Chomsky)– Not just learn by imitation; use grammar / syntax
  - Convert 2 surface structures to 1 deep structure
    - Mary kissed John & John was kissed by Mary = Mary kisser; John kisse



- Convert 1 surface structure to 2 deep structure
  - Bill heard the trampling of the hikers= Bill heard the hikers trampling (something)



Bill heard (someone) trampling the hikers

JFK – "Ich bin ein Berliner."  
" I am a jelly donut"  
" I am a citizen of Berlin"

- Language acquisition device – innate mental module that allows young children to develop language, if exposed



Even when parents try to correct their children's syntax, it doesn't usually work.



# Evidence That Supports Chomsky

1. Children in different cultures; similar states of linguistic development.
    - Add no to beginning - “no get dirty”
    - Double negative – “he don’t want no milk”
  2. Children combine words in ways that adults never would.
    - “Daddy taked me”, “Go store” , “I waked up”
  3. Adults do not consistently correct their children’s syntax.
    - Usually parents reward incorrect syntax
    - “want milk” = mother will serve milk
  4. Children not exposed to adult language may invent their own.
    - Deaf children create their own sign language
  5. Infants (7 months) can derive simple linguistic rules from string of sound.
    - If learn ABA pattern until bored will want ABB
    - If learn ABB pattern until board will want ABA
      - ABB = “Wo fe fe”
      - ABA = “Wo fe wo”
- Therefore....language acquisition replaced language learning

# Nay Sayers to Chomsky

- Some think experience has a greater role
- Experience: probability that any given word or syllable will follow another