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# Chapter 8: Thinking, Language, and Intelligence

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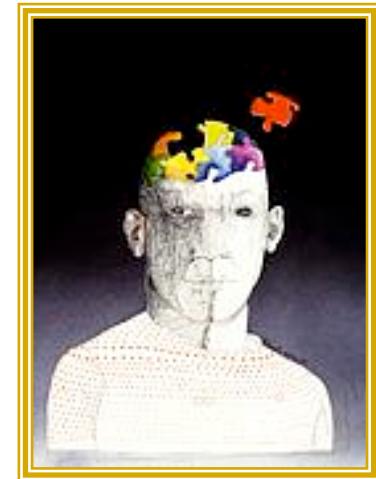
# Lecture Overview

- Thinking
- Language
- Intelligence
- The Intelligence Controversy

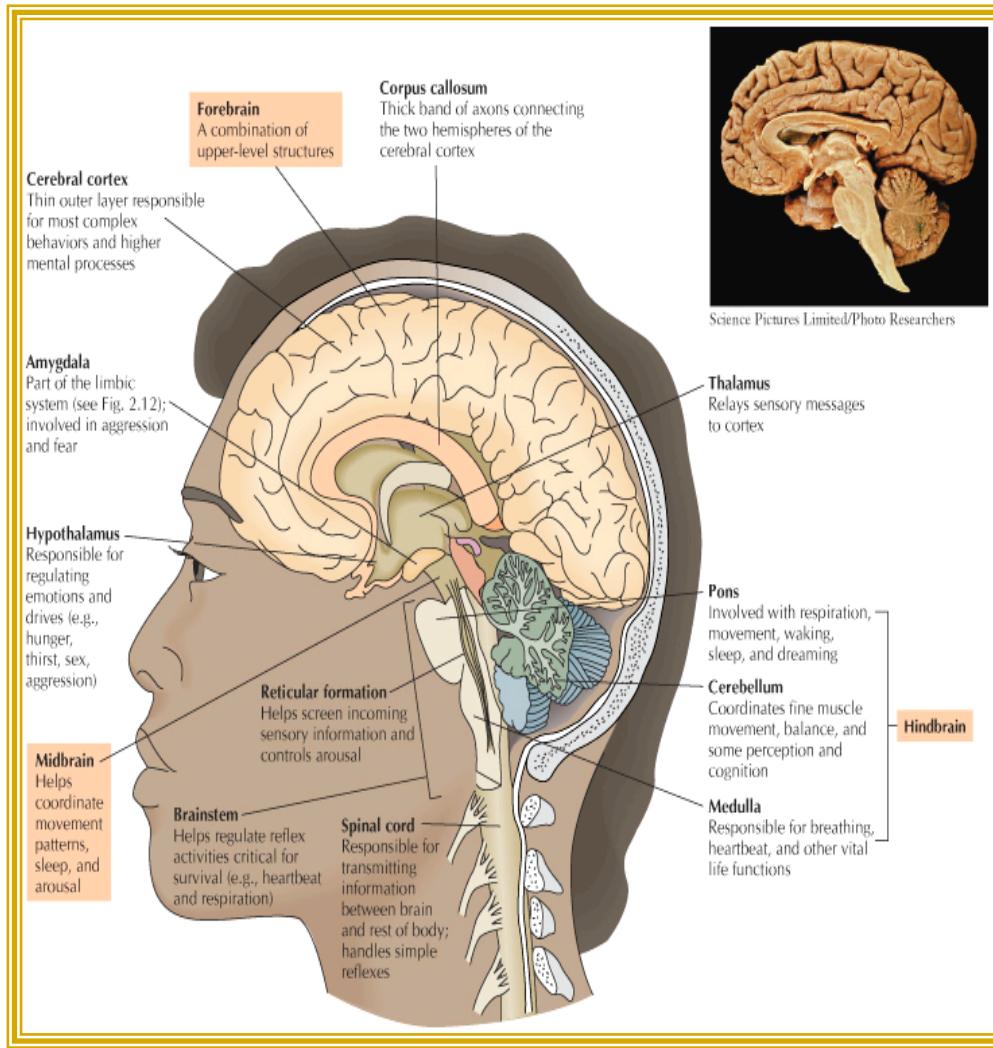


# Chapter Introduction

- Thinking, language, and intelligence are often studied under the larger topic of cognition (mental activities involved in acquiring, storing, retrieving, and using knowledge).



# Thinking



- Cognitive building blocks.
- The processes of thinking are distributed throughout the brain, especially in the frontal lobe

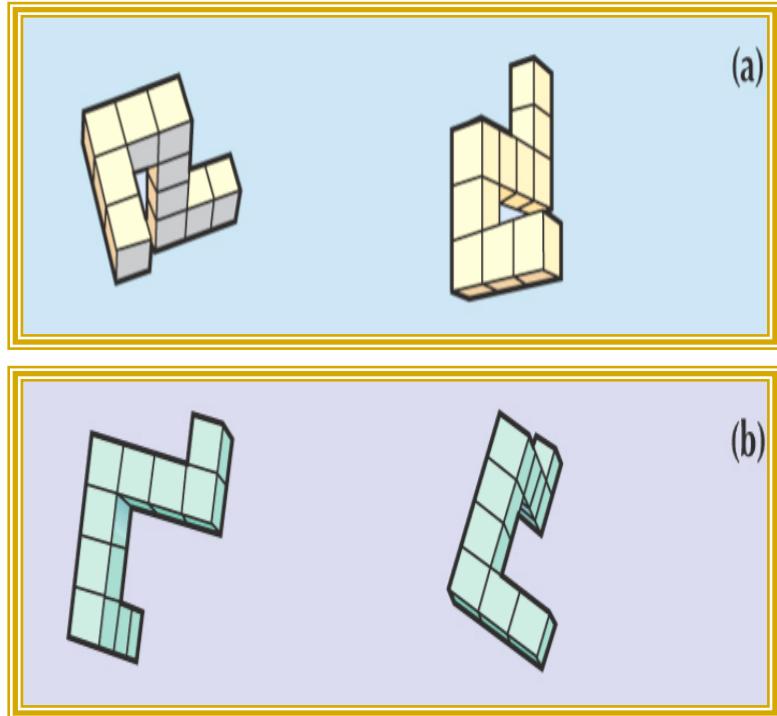
# Thinking—Three Components (Mental Images)

- 1. Mental Images  
(mental representations of a previously stored sensory experience, including visual, auditory, etc.)



# Thinking—Three Components

## (Mental Images Continued)



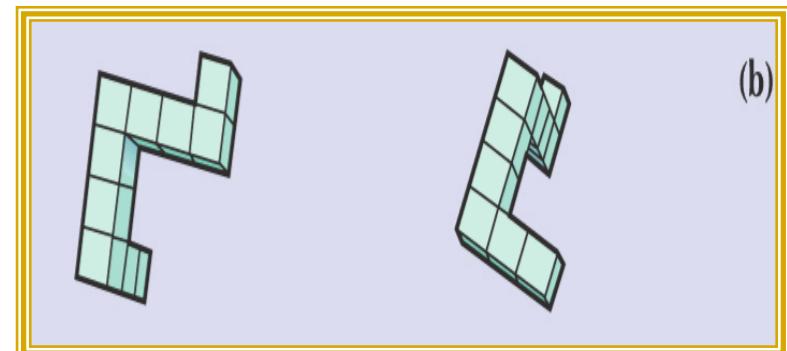
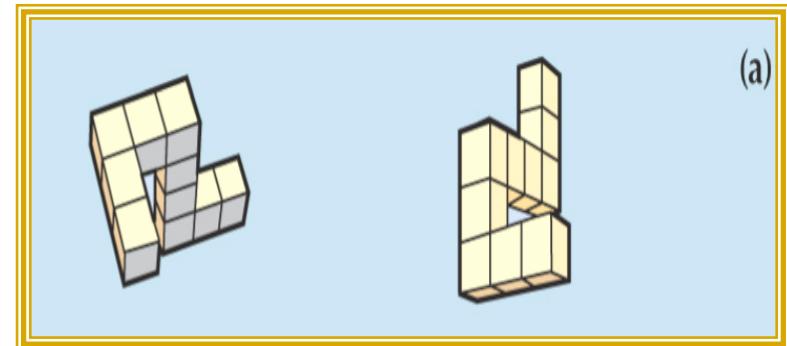
- Why are the two forms in (a) the same, yet the two forms in (b) are different? Solving this problem requires mental manipulation of the mental images.

# Thinking—Three Components

## (Mental Images Continued)

### ■ Mental Image Solution:

To solve the problem  
rotate one of the  
objects in (b) and then  
compare the rotated  
image with the other  
object to see whether  
they match or not.

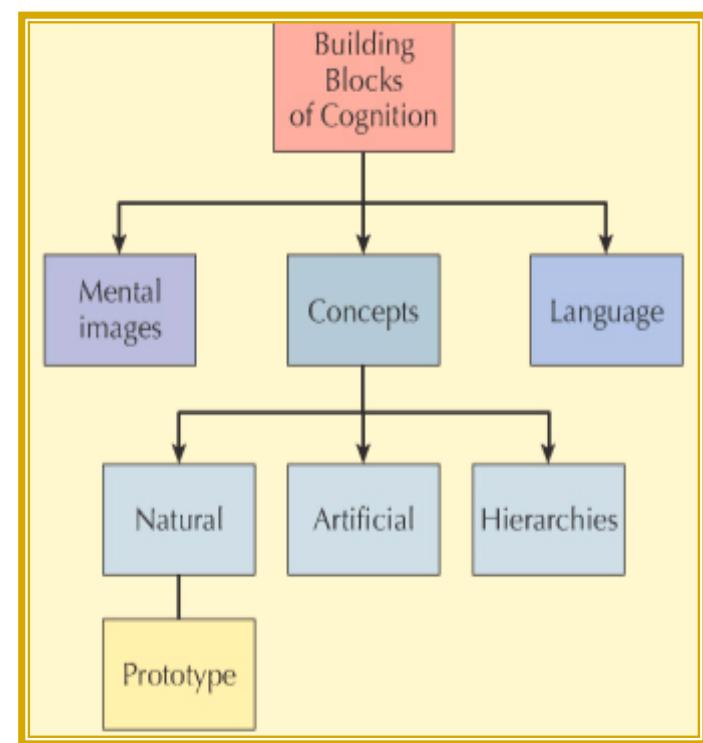
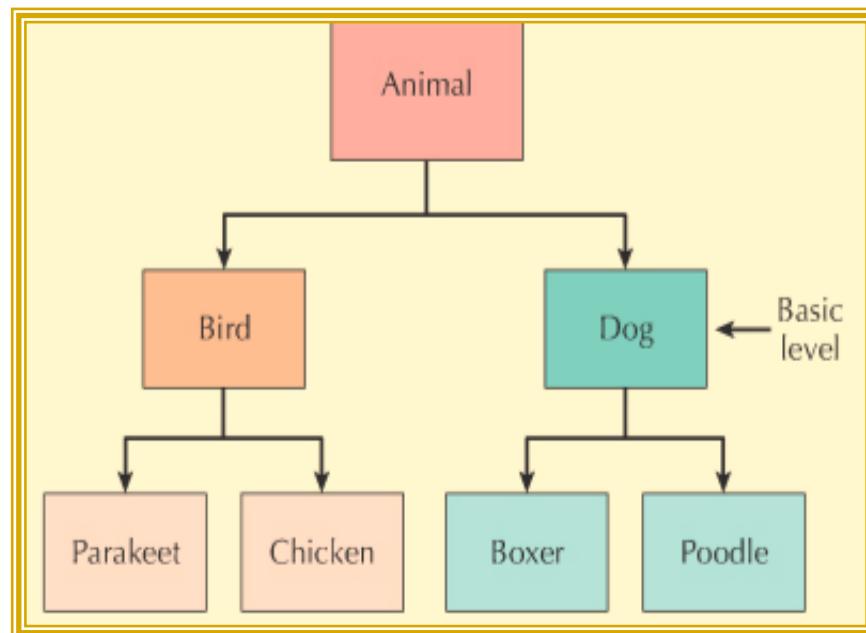


# Thinking—Three Components (Concepts)

2. Concepts (mental representation of a group or category that shares similar characteristics)
  - How do we learn concepts?
    - a. Artificial concepts are formed by logical, specific rules.
    - b. Natural concepts/prototypes are formed by our experiences in everyday life.
    - c. Hierarchies help us group concepts into subcategories within broader categories.

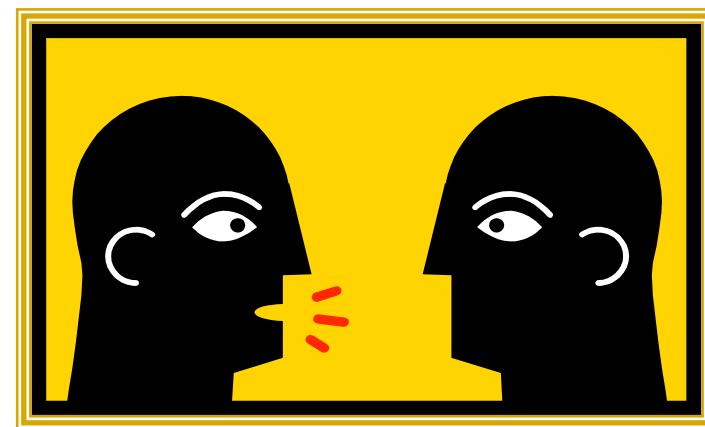
# Thinking—Three Components

## An Example of Hierarchies



# Thinking—Three Components (Language)

3. Language (a form of communication using sounds and symbols combined according to specified rules)

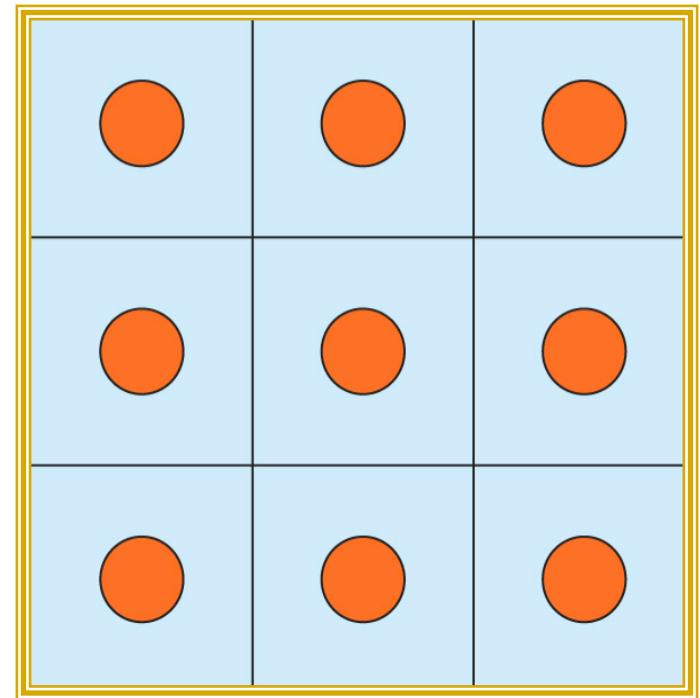


# Thinking—Problem Solving

- Step 1: Preparation- identifying, separating, and defining.
- Step 2: Production- generating possible solutions (*hypotheses*) by using algorithms and heuristics.
- Step 3: Evaluation- judging hypotheses in Step 2 against the criteria in Step 1.

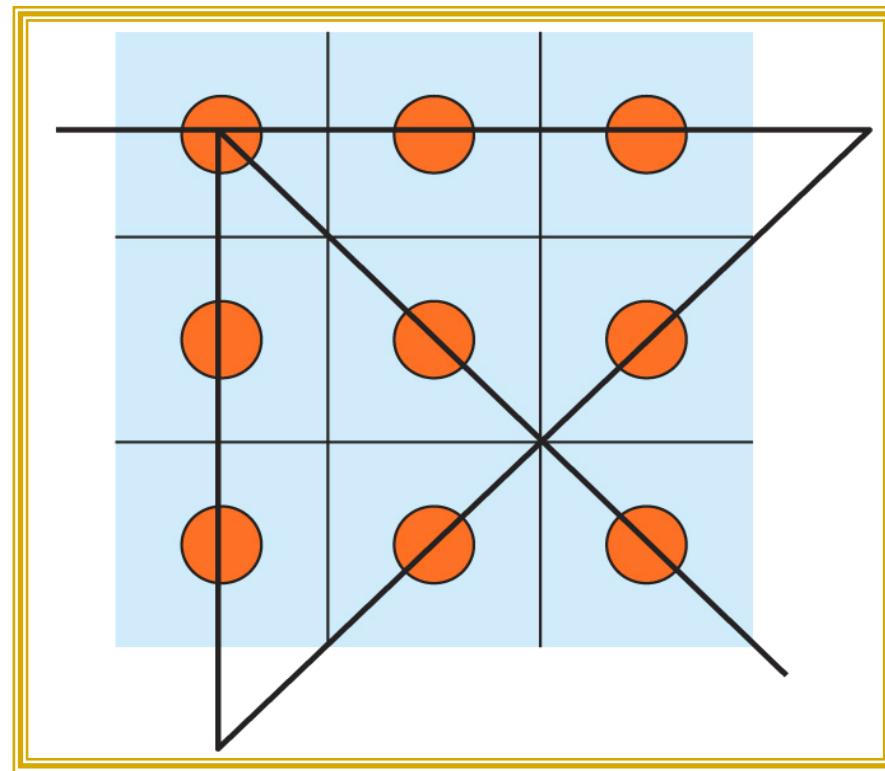
# Thinking—Five Key Barriers to Problem Solving

- 1. Mental Sets  
(persistence in using strategies that have worked in the past)
- Using no more than four lines, can you connect all nine dots without lifting your pencil from the paper?



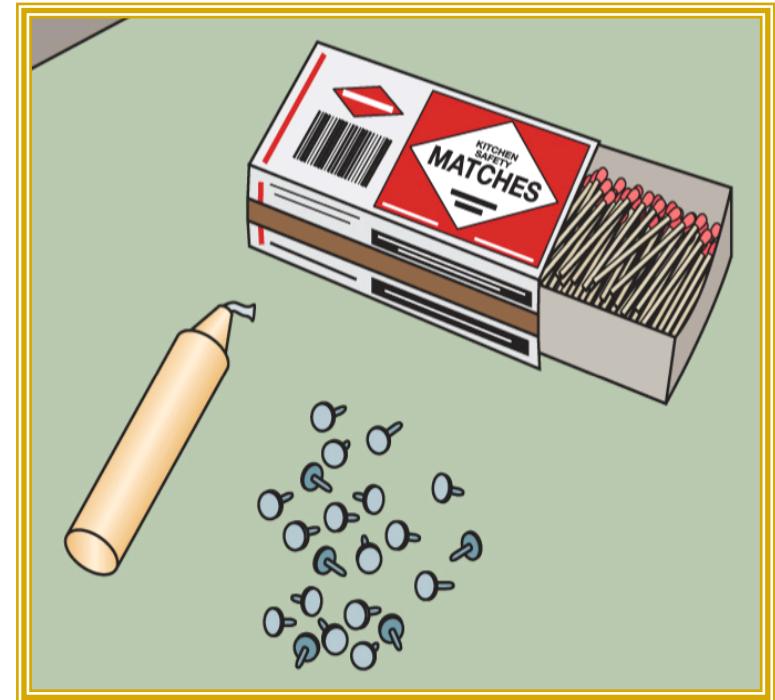
# Thinking—Five Key Barriers to Problem Solving (Mental Sets Continued)

- To overcome mental sets you must “think outside the box”—literally!



# Thinking—Five Key Barriers to Problem Solving

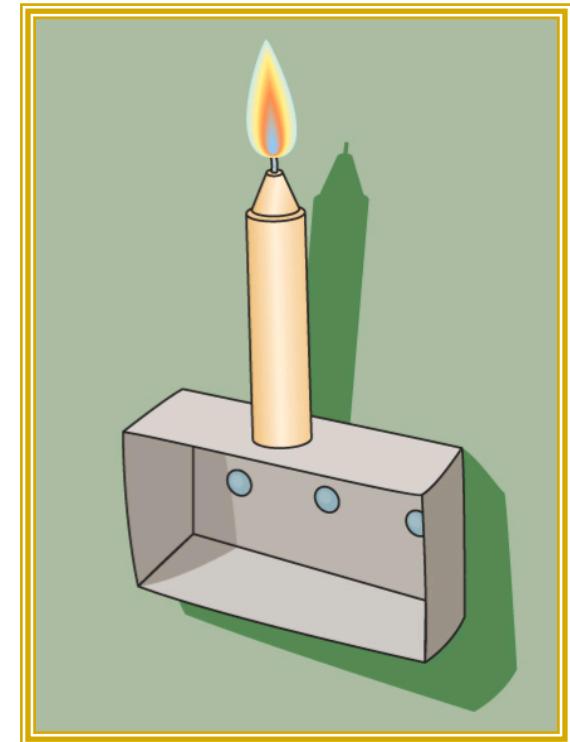
- 2. Functional Fixedness  
(thinking of an object as only functioning in its usual way)
- Can you use these supplies to mount the candle on the wall so that it can be lit in a normal way without toppling over?



# Thinking—Five Key Barriers to Problem Solving

## (Functional Fixedness Continued)

- To overcome functional fixedness, you must think of the matchbox, tacks, and candle all functioning in new ways.



# Thinking—Five Key Barriers to Problem Solving

- 3. Confirmation Bias (preferring information that confirms preexisting positions or beliefs, while ignoring contradictory evidence)
  
- 4. Availability Heuristic (judging the likelihood of an event based on how readily *available* other instances are in memory)

# Thinking—Five Key Barriers to Problem Solving

- 5. Representativeness Heuristic [estimating the probability of something based on how well the circumstances match (or *represent*) a previous prototype]
- When people overestimate the dangers of flying is it an example of the availability heuristic or the representativeness heuristic?



# Thinking—Creativity

- Creativity (ability to produce valued outcomes in a novel way)
  - Three elements of creativity:
    - *Originality*
    - *Fluency*
    - *Flexibility*

 TABLE 8.2 THREE ELEMENTS OF CREATIVE THINKING

	Explanations	Thomas Edison Examples
<b>Originality</b>	Seeing unique or different solutions to a problem	After noting that electricity passing through a conductor produced a glowing red or white heat, Edison imagined capturing this light for practical uses.
<b>Fluency</b>	Generating a large number of possible solutions	Edison tried literally hundreds of different materials to find one that would heat to the point of glowing white heat without burning up.
<b>Flexibility</b>	Shifting with ease from one type of problem-solving strategy to another	When he couldn't find a long-lasting material, he thought of heating it in a vacuum—thereby creating the first lightbulb.

# Thinking—Creativity

- Divergent thinking (ability to produce many alternatives or ideas) is linked to creativity (e.g., reordering these letters “grevenidt” to form many new words).
- Convergent thinking (attempting to find one correct answer) is linked to conventional, non-creative thinking (e.g.,  $2 + 2 = ?$ ).



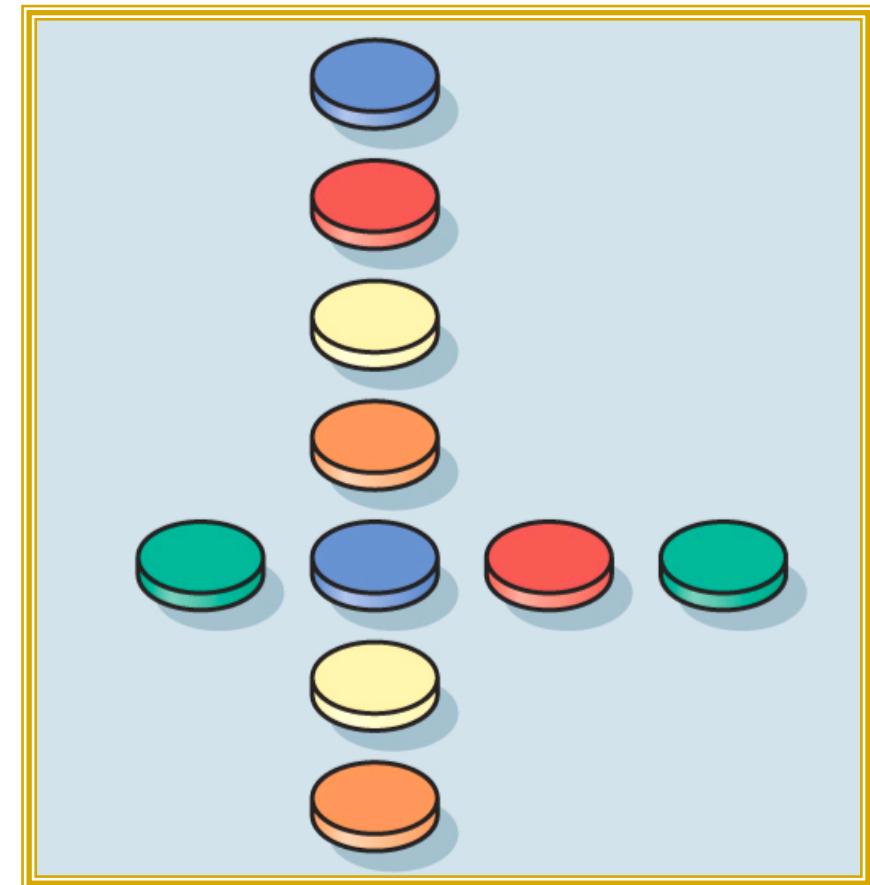
**TABLE 8.3 RESOURCES OF CREATIVE PEOPLE**

Intellectual Ability	Knowledge	Thinking Style	Personality	Motivation	Environment
Enough intelligence to see problems in a new light	Sufficient basic knowledge of the problem to effectively evaluate possible solutions	Novel ideas and ability to distinguish between the worthy and worthless	Willingness to grow and change, take risks, and work to overcome obstacles	Sufficient motivation to accomplish the task and more internal than external motivation	An environment that supports creativity

# Thinking—Creativity

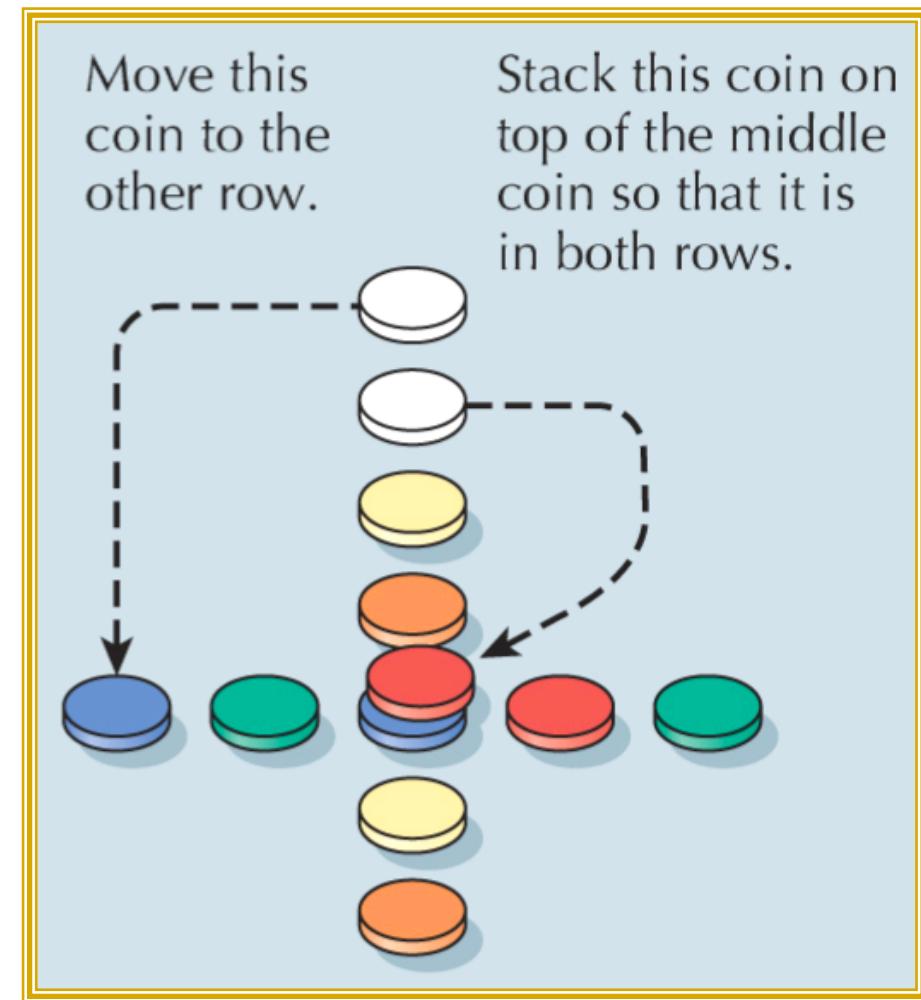
- Want to test your creativity?

Arrange 10 coins in the configuration shown here. Then, by only moving two coins, create two rows of 6 coins.



# Thinking—Creativity

- Can you see how this is a **creative** solution to the 10 coin problem?



# Language: Three Building Blocks

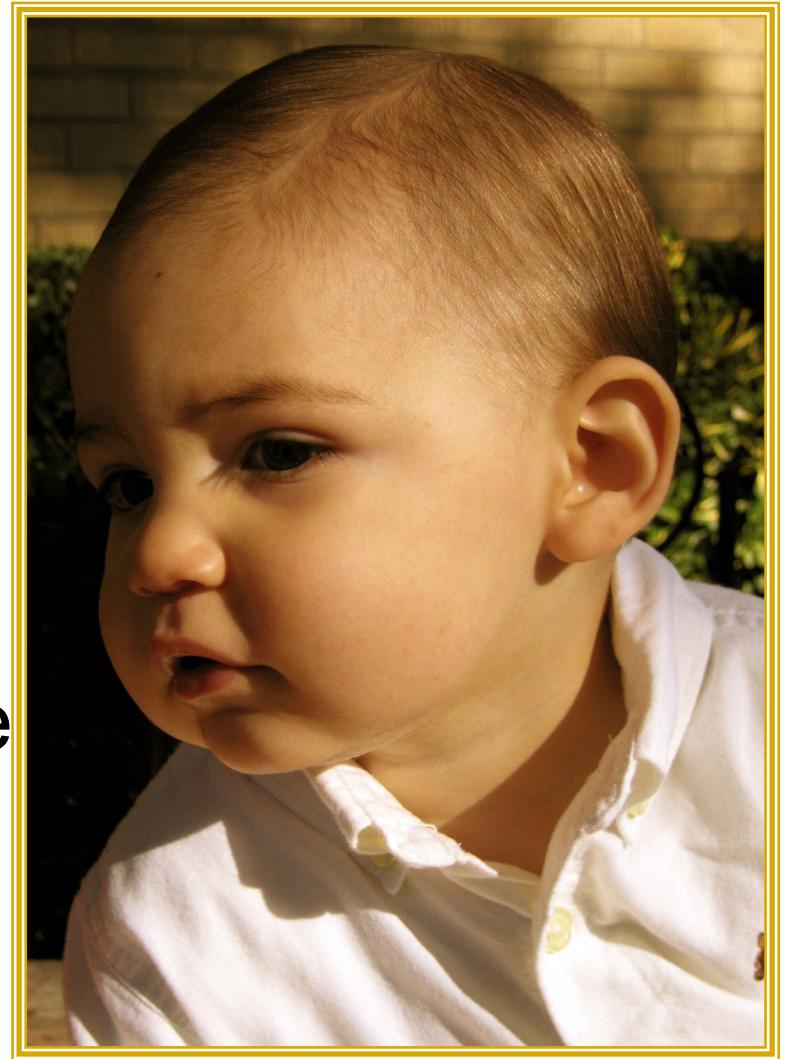
1. **Phoneme** (smallest unit of speech or sound)
2. **Morpheme** (smallest meaningful unit of language)
3. **Grammar** (rules specifying how phonemes, morphemes, words, and phrases should be combined to express thoughts)
  - **Syntax** (rules for word order)
  - **Semantics** (system of using words to create meaning)

## SUMMARY TABLE 8.4 BUILDING BLOCKS OF LANGUAGE

Blocks	Description	Example
<b>Phonemes</b>	The smallest units of sound that make up every language	<i>p</i> in pansy; <i>ng</i> in sting
<b>Morphemes</b>	The smallest units that carry meaning; they are created by combining phonemes. ( <i>Function morphemes</i> are prefixes and suffixes. <i>Content morphemes</i> are root words.)	<i>unthinkable</i> = <i>un</i> • <i>think</i> • <i>able</i> (prefix = <i>un</i> , root word = <i>think</i> , suffix = <i>able</i> )
<b>Grammar</b>	A system of rules (syntax and semantics) used to generate acceptable language that enables us to communicate with and understand others	<i>They were in my psychology class.</i> versus <i>They was in my psychology class.</i>
<b>Syntax</b>	A system of rules for putting words in order	<i>I am happy.</i> versus <i>Happy I am.</i>
<b>Semantics</b>	A system of using words to create meaning	<i>I went out on a limb for you.</i> versus <i>Humans have several limbs.</i>

# Language Development

- Prelinguistic Stage  
(crying, cooing, and babbling)
- Linguistic Stage (single-utterances, telegraphic speech, and learning the rules of grammar)



# Theories of Language Development

- **The Nature Perspective:** language is an inborn capacity and develops primarily by maturation.
  - Chomsky's language acquisition device (LAD)
- **The Nurture Perspective:** language develops from a complex system of rewards, punishments, and imitation



# Intelligence

- Intelligence (global capacity to think rationally, act purposefully, and deal effectively with the environment)
- Intelligence is a *hypothetical, abstract construct.*



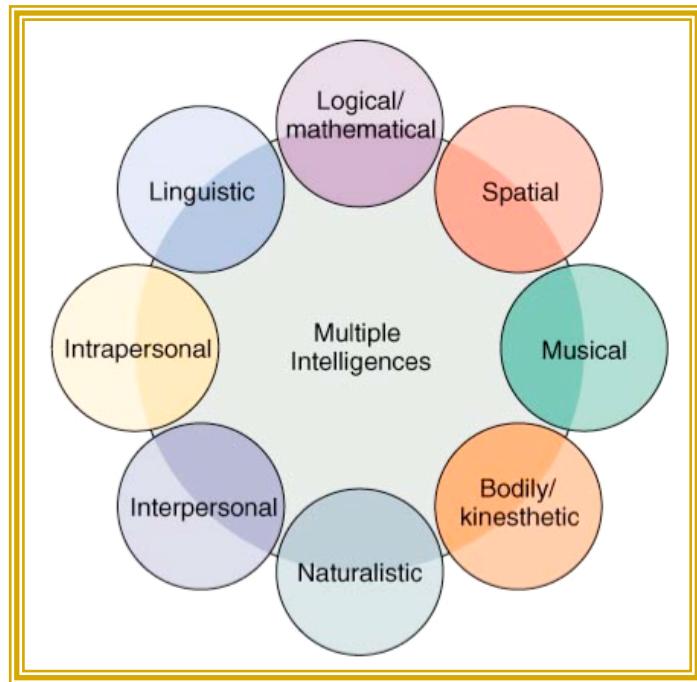
# What Is Intelligence?

## Historical views of intelligence:

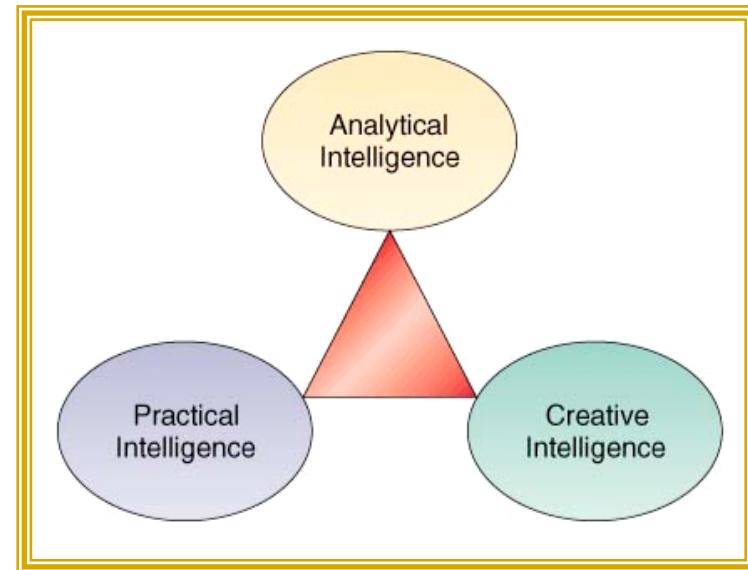
1. Single ability or general factor called “g” (Spearman)
2. Multiple abilities (Thurstone and Guilford)
3. Single ability with two types of g, fluid and crystallized intelligence (Cattell)
4. Multiple abilities (Gardner and Sternberg)

# Intelligence Models

## ■ Gardner



## ■ Sternberg



**TABLE 8.5 GARDNER'S MULTIPLE INTELLIGENCES AND POSSIBLE CAREERS**

Linguistic: language, such as speaking, reading a book, writing a story	Spatial: mental maps, such as figuring out how to pack multiple presents in a box or how to draw a floor plan	Bodily/ kinesthetic: body movement, such as dancing, hitting a baseball, or skiing	Intra- personal: understand ing oneself, such as setting achievable goals or recognizing self- defeating emotions	Logical/ mathematical: problem solving or scientific analysis, such as following a logical proof or solving a mathematical problem	Musical: musical skills, such as singing a song or playing the piano	Inter- personal: social skills, such as talking with other people	Naturalistic: Being attuned to nature, such as noticing seasonal patterns or using environmentally safe products	Spiritual/ Existential: <i>(Speculative)</i> Attunement to meaning of life and death and other conditions of life
Careers: novelist, journalist, teacher	Careers: engineer, architect, pilot	Careers: athlete, dancer, ski instructor	Careers: increased success in almost all careers	Careers: mathematician, scientist, engineer	Careers: singer, musician, composer	Careers: sales- person manager, therapist, teacher	Careers: biologist, naturalist	Careers: philosopher, theologian

**TABLE 8.6** STERNBERG'S TRIARCHIC THEORY OF SUCCESSFUL INTELLIGENCE

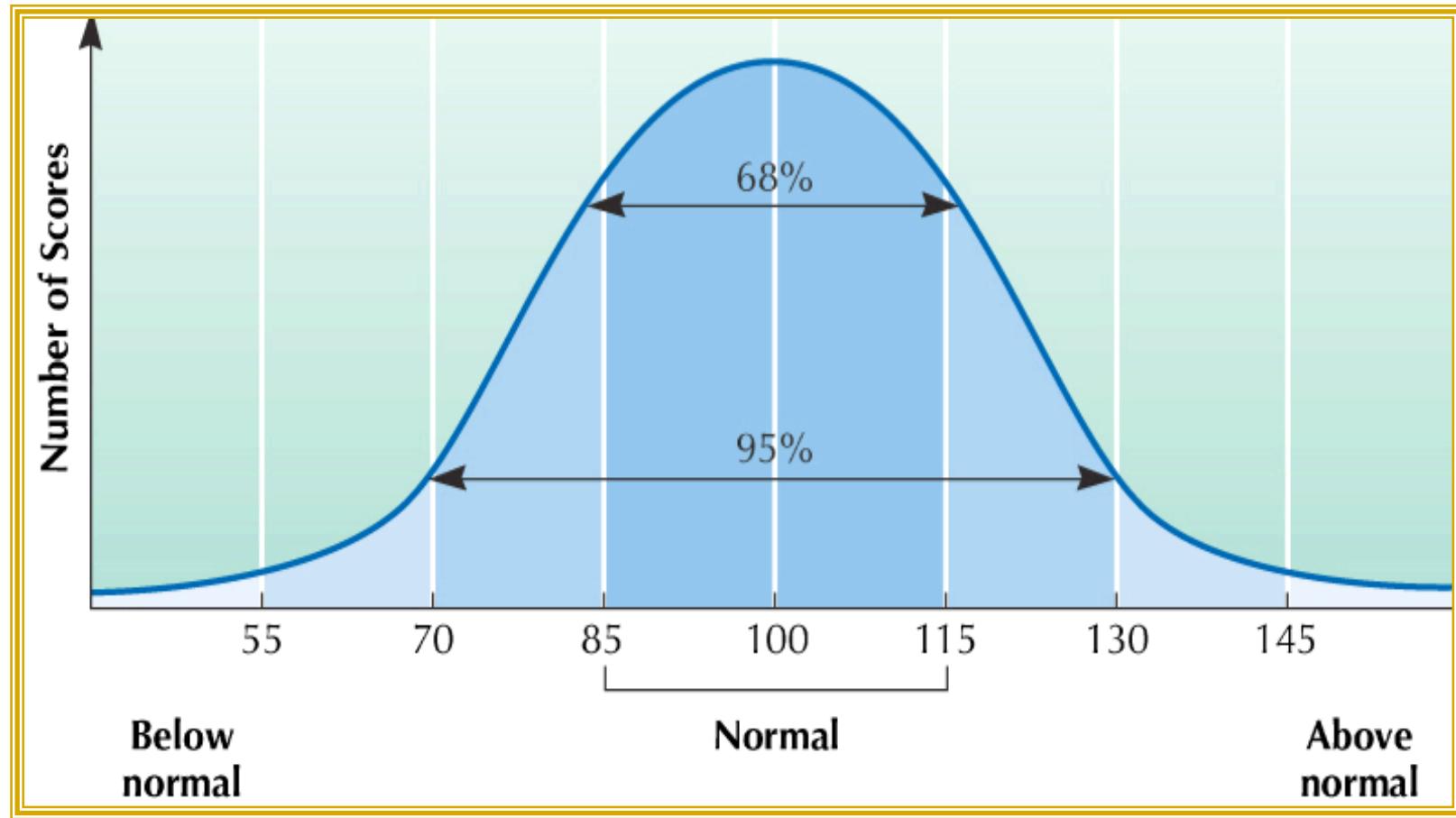
	Analytical Intelligence	Creative Intelligence	Practical Intelligence
<b>Sample Skills</b>	Good at analysis, evaluation, judgment, and comparison skills	Good at invention, discovery, coping with novelty, and imagination skills	Good at application, implementation, execution, and utilization skills
<b>Methods of Assessment</b>	These skills are assessed by any of the intelligence or scholastic aptitude tests. Questions ask about meanings of words based on context and how to solve number-series problems.	These skills are assessed in many ways, including open-ended tasks, such as designing an invention, writing a short story, drawing a piece of art, creating an advertisement, or solving a scientific problem requiring insight.	Although these skills are more difficult to assess, they can be measured by asking for solutions to practical and personal problems.



# Measuring Intelligence

- Stanford-Binet and Wechsler most widely used individual intelligence tests. Both tests compute an intelligence quotient (IQ), which compares the deviation of a person's test score to norms for that person's age group.
  - Original version of Stanford-Binet ( $IQ = MA/CA \times 100$ )

# Measuring Intelligence— The Normal Distribution of IQ Scores



# Measuring Intelligence— Sample Wechsler Tests

**Performance Subtests** Example below:

**Picture Completion**

What is missing from this ambulance?



1	2	3	4	5					
●	*	*	*	*	*	*	*	*	*

**Coding**

Write the appropriate number above each symbol.



**Picture Arrangement**

Arrange these pictures in chronological order.



**Block Design**

Copy this design with blocks.



**Object Assembly**

Assemble this small jigsaw puzzle.

**Verbal Subtests**

Information

Similarities

Arithmetic

Vocabulary

Comprehension

How many senators are elected from each state?

How are computers and books alike?

If one baseball card costs three cents, how much will five baseball cards cost?

Define *lamp*.

What should you do if you accidentally break a friend's toy?

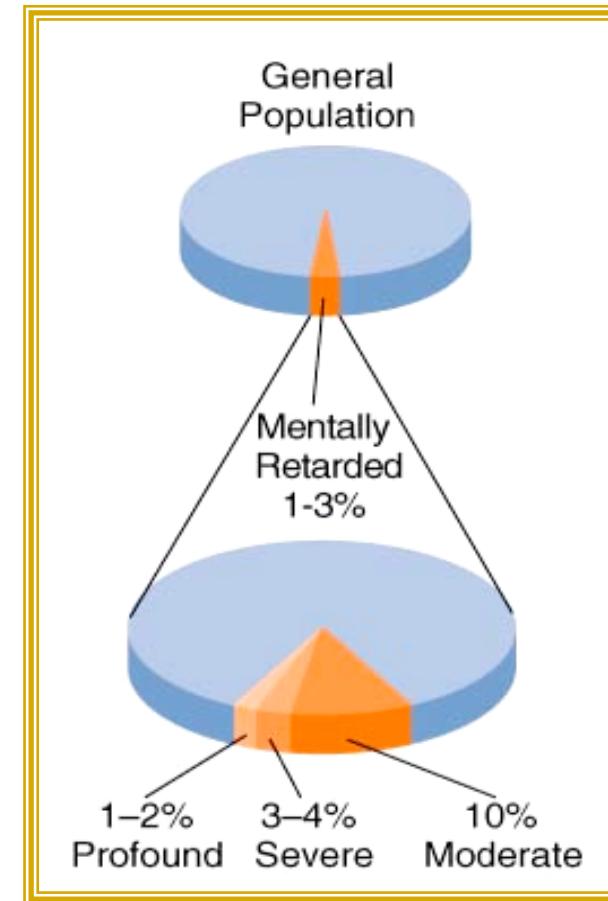
# Measuring Intelligence

- Three scientific standards for psychological tests:
  1. **Standardization** establishes norms and uniform procedures for giving and scoring a test.
  2. **Reliability** is a measure of the consistency and stability of test scores over time.
  3. **Validity** is the ability of a test to measure what it was designed to measure.



# The Intelligence Controversy—Extremes in Intelligence

- Mental Retardation (IQs of 70 and below)
- Mental Giftedness (IQs of 135 and above)

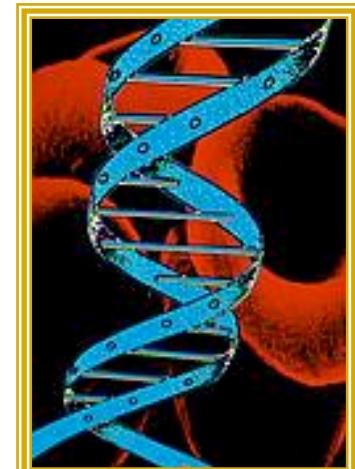


**SUMMARY TABLE 8.8 DEGREES OF MENTAL RETARDATION**

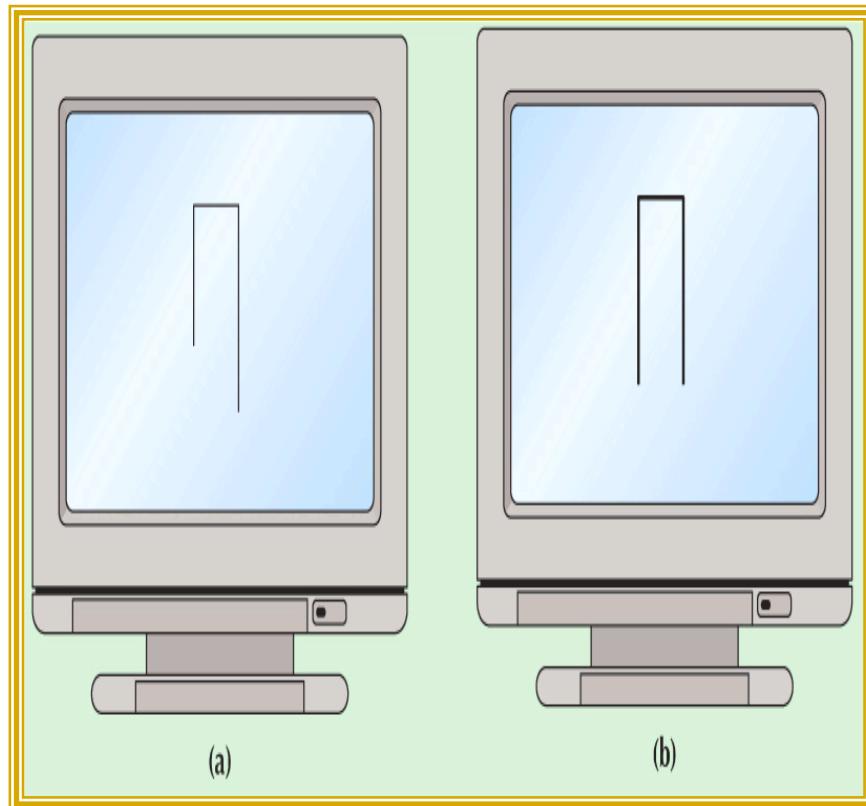
Level of Retardation	IQ Scores	Percent of Mentally Retarded Population	Characteristics
Mild	50–70	85	Usually able to become self-sufficient: may marry, have families, and secure full-time jobs in unskilled occupations
Moderate	35–49	10	Able to perform simple unskilled tasks; may contribute to a certain extent to their livelihood
Severe	20–34	3–4	Able to follow daily routines, but with continual supervision; with training, may learn basic communication skills
Profound	below 20	1–2	Able to perform only the most rudimentary behaviors, such as walking, feeding themselves, and saying a few phrases

# The Intelligence Controversy: Explaining Differences

- **Is it the brain?** All mental activity (including intelligence) results from neural activity in the brain.
- **Is it genetic or environmental influences?** Heredity and environment are important, inseparable factors in intellectual development.

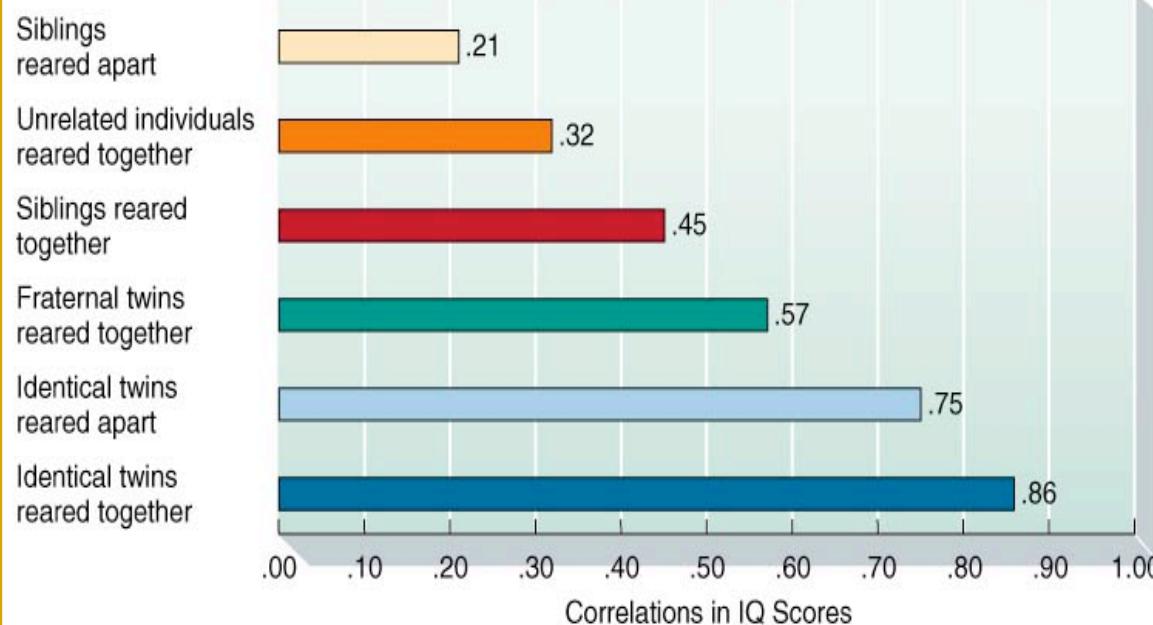


# An Example of a “Brain” Test for Intelligence? Which “leg” of the drawing is longer (a) or (b)?



- When images are *quickly flashed*, the amount of time someone needs to make a correct choice may reveal something about intelligence.

# An Example of “Genetic Vs. Environmental” Influences on Intelligence



# The Intelligence Controversy: Are IQ Tests Culturally Biased?

- Some ethnic groups score differently on IQ tests, but there are numerous contributing factors, including stereotype threat.

