9.00 EXAM 2 NOTES

KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

LANGUAGE: More than Meaningful Sounds

Language Production: the ability to use words, phrases, and sentences to convey information

- *Generative* → we can arrange words in countless new combinations to produce novel sentences; not just retrieving / repeating stored sentences

Language Comprehension: the ability to understand the messages conveyed by words, phrases, and sentences

Language consists of simple building blocks that can be combined in many ways according to specific rules:

- Phonology
- Syntax
- Semantics
- Pragmatics

PHONOLOGY: the structure of the sounds of the words in a language

Phonemes: basic building block of speech sounds; small, basic sound from a fixed set that specifies the building blocks of speech sounds that humans are capable of producing

- Humans can produce 100 phonemes → English only uses 45 of these

SYNTAX: the internal organization of a sentence determined by a set of rules (grammar) for combining different parts of speech into acceptable arrangements; rules for how *words* can be organized into sentences

- Vs. Grammar: rules that specify how different *parts of speech* (ex: nouns, verbs, adjectives) can be combined to form sentences
- Ex: Noun + Verb
- When you read, you organize the material in terms of the syntax of the sentences

SEMANTICS: the meaning of a word, phrase, or sentence

Morphemes: smallest unit of meaning in a language

- Ex: adding prefixes, suffixes, -ing, -ed
- There are rules governing how morphemes can be combined, but morphemes can be combined in many ways to create many, meaningful words.

Meanings are often assigned arbitrarily to different sounds or written words.

- Ex: who decided that the word "dog" refers to a dog? What if "dog" really referred to cat?

The meaning of a sentence and its syntax are distinct → different parts of the brain are involved in processing semantics and syntax.

- Ex: good syntax, bad semantics – Colorless green ideas sleep furiously.
- Ex: bad syntax, good semantics – Fastly dinner eat, ballgame soon start; Yoda speech

Syntax and semantics can interact! Sentences are easiest to understand when named objects appear in the same order in the sentence as they do in the corresponding event

PRAGMATICS: the ways that words and sentences in a language convey meaning indirectly, by implying rather than asserting

- Plays a key role in understanding humor and metaphors (direct comparisons of 2 things in which one is described as being the other)

9.00 EXAM 2 NOTES

KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

Phonology, syntax, and semantics depend primarily (in right-handed people) on the left cerebral hemisphere, but the ability to understand metaphors, as well as humor, depend crucially on the brain's right hemisphere.

→ *These 4 aspects of language constantly interact!!*

Bilingualism

Are there differences in how first and second languages are acquired and used?
Kim et al. (1997) – used fMRI to scan brains of 2 groups of bilingual people while they thought about what they had done the previous day, using each of their two languages in turn.

- 2 Groups = learned 2nd language as young children vs. as adults
- Brain area involved in comprehension (back part of the left temporal lobe) – activated in same way with both languages, in both groups
- Other brain areas behaved differently for those who had learned the language as young children than for those who had learned the language as adults.
    - Evidence that language was processed differently by those who learned it as adults.
- People who learned 2nd language as an adult had activations in part of the left frontal lobe (involved in working memory)
    - Language learned during childhood is "automatic," it doesn't require "thinking through what you are saying," whereas language learned as an adult does require such extra effort.

The rate of learning new vocabulary words in a 2nd language is remarkably close to the learning rates of children who are reading in their native languages.

Grammar / phonology are not easily picked up in a 2nd language.

People with good musical ability can learn to pronounce words in another language better than people who do not have good musical ability.

The more formal education you have and the younger you are when you start, the better you will be at learning a 2nd language.

MEANS OF THINKING: The Mental Tool Kit

Mental Images: mental contents like those that arise during perception, but they arise from stored information rather than on immediate sensory input

→ Thinking relies on mentally manipulating information, and information is stored in various ways

Words: Inner Speech and Spoken Thoughts

- John B. Watson – thinking is just talking to yourself

Problems with this idea:

- Words are ambiguous, thoughts are not.
- We sometimes have trouble putting thoughts into words… if thoughts were already formed in language, expressing them should be easy!
- Animals can think, but they don't use language?

Linguistic Relativity Hypothesis: the idea that language shapes our perceptions and thoughts, and thus people who speak different languages think differently

- Championed by Benjamin Lee Whorf

9.00 EXAM 2 NOTES

KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

Eleanor Rosch: tested linguistic relativity hypothesis by studying Dani (remote tribe in Papua New Guinea)

- Expt: people who speak languages with lots of different words for colors should perceive more distinctions among colors than people who speak languages with few such words?
  - FALSE → Dani use only 2 words for color, but they perceive variations in color and can learn shades of color as readily as people who speak languages with words that label many colors

Language does not entirely shape our perceptions thoughts.
We can use words as a crutch to help us think, especially with working memory tasks.
Language can enhance memory.
The written version of a language may affect thought.
Ex: English speakers think of time as horizontal; Chinese think of time as vertical

Mental Imagery → "seeing with the mind's eye"

VISUAL MENTAL IMAGERY

- Relies on many of the same parts of the brain (92%) as are used in visual perception

3 Properties:

1. Spatial Extent → how much an object extends over a specific portion of space
   - Tested by visual scan
   - Patterns of activation in the brain specify the shape, color, and spatial extent of objects
   - Many of the areas of the brain that process visual input are organized so that the images on the retina are laid out on the cortex in *topologically organized area*s
     - When people visualize with their eyes closed, these areas in the occipital and parietal lobes usually are active
     - If such areas in the occipital lobe are temporarily impaired by TMS, people have difficulty forming visual mental images
2. Limited Size → your field of view spans only a certain angle (spread)
   - Bigger objects need to be "seen" farther away to fit in it (ex: elephant vs. rabbit)
   - Why? Objects in visual mental images overflow at about the same spatial extent that actual objects seem to become blurred in perception.
     - Because our eyes only have limited scope, our brains needed only to process that limited field of view, and this property also affects our mental images.
3. Limited Resolution → limited level of distinguishing fine details (if an object is too small, you have trouble distinguishing all of its parts)
   - People need more time to "see" properties of objects that are visualized at small sizes than those visualized at larger sizes
   - Can be explained by topographically organized brain areas: The brain areas used in perception evolved to process what the eyes send them, and our eyes have only a limited resolution.
     - Think of an HDTV!

Other types of imagery: auditory, motor, spatial, manipulating (ex: rotating objects 90 degrees)

- In each of these cases, imagery relies on brain mechanisms used for other purposes (ex: perception, controlling movement)

Limitations of mental images as vehicles of thoughts

- Abstract concepts (ex: justice)
- Ambiguity in images
- Not everyone can produce good images

Concept: the idea that underlies the meaning of a word or image, depending on the language, some concepts can be expressed with a single word or may require a phrase or two to be fully expressed

9.00 EXAM 2 NOTES

KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

- Must be unambiguous; can be concrete or abstract
- Can be expressed by words and images, but they are not the same as the other!

Aristotle → a given concept is defined by a set of features
- Ex: concept = bird; features = feathers, wings, beak, ability to fly
- Problems: features can be unclear (especially for abstract concepts); makes wrong predictions; concepts are not "all-or-none"!
    - Some concepts fit better to certain objects over others (ex: "bird" applies better to robin than emu)
    - How well a concept applies depends on an entity's **typicality**: the degree to which an entity is representative of a concept

Prototype: the most typical example of a concept
- A concept is specified as a set of features that describe the prototype.
- Only a percentage of those features need to be present in any particular member or in order to apply the concept. (Ex: Emu has enough "bird features" to fit the "bird concept")

Some types of concepts are not stored as prototypes. Rather, they are stored as sets of examples of the concept or as functions

Concepts are organized in terms of specificity, and when classifying an object or event, we typically use a concept at the **basic level**: an intermediate level of specificity that is usually the most likely to be applied to an object (usually has more general concepts above it and more specific concepts below it); is as general as possible, which still being limited to the object in question

Ex: apple (has fruit above it; Granny Smith below it)

Rosch → ways to identify the basic level:
- Similarity of shapes of the members of concepts at different levels of specificity

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PROBLEM SOLVING AND REASONING: From Mental Processes to Behavior

Problem: an obstacle that must be overcome to reach a goal
Problem Solving: devising a way to overcome an obstacle that stands between the present situation and a desired goal
Reasoning: deciding what follows from an idea, ideas, or a situation
Representation problem: the challenge of how best to formulate the nature of a problem
Functional fixedness: when solving a problem, getting stuck on one interpretation of an object or one aspect of the situation
Finding the right representation for a problem can be tricky because once you think of a problem in a certain way (**mental set**), you may find it difficult to drop this view and try out others.
Strategy: an approach to solving a problem, which indicates the processing steps to be tried
Algorithm: a set of steps that, if followed methodically, will guarantee the solution to a problem
Heuristic: a rule-of-thumb strategy that does not guarantee the correct answer to a problem but offers a likely shortcut to it
Ex: break the problem into parts, work backwards, guess and check
Solving problems by analogy: comparing features of 2 situations and noticing what they have in common / what is different

→ *See p. 210, Table 1 for a summary of Approaches to Problem Solving*

Other Ways to Improve Your Ability to Solve Problems:
1. Represent the problem effectively / understand the problem

2. Focus on the problem (don't get so set on finding the solution that you forget what the question is asking!)
3. Don't restrict the resources (a form of functional fixedness)
4. Consider alternative types of solutions (different **mental sets**: an approach to solving a problem that worked for a similar problem in the past, which leads to a fixed way of thinking about how to solve a present problem)
5. Take a fresh look

LOGIC, REASONING, AND DECISION MAKING

Logic: a set of rules that determines which conclusions follow from particular assumptions

Deductive reasoning: reasoning that applies the rules of logic to a set of assumptions (stated as premises) to discover whether certain conclusions follow from those assumptions; goes from general to the particular

- General principles (premises) → Specific example to which principles (premises) apply → Conclusions based on application of general principles to specific example

Inductive Reasoning: reasoning that uses examples to discover a rule that governs them; goes from the particular (examples) to the general (a rule)

- Observation of individual examples → Notice of regularities in specific examples → Induction of general principles

LOGICAL ERRORS

Affirming the consequent: assuming that a specific cause is present because a particular result has occurred

Confirmation bias: tendency to seek information that will confirm a rule, and not to seek information that would refute the rule

- **IMPORTANT → Wason and Johnson-Laird Card Task**: "If a card has a vowel on one side, then it will have an even number on the other side."
    - The cards are: A D 4 7. How many / which ones do you flip over to decide if the rule is true?
    - Answer: A and 7
    - Most people flip A to see whether an even number is on the other side (confirms rule)
    - Not many people pick 7. If there is a vowel on the other side of 7, then the rule is wrong no matter what's on the reverse of A (refutes rule)

PROBLEMS WITH HEURISTICS

Representativeness heuristic: strategy in which we assume that the more similar something is to a prototype stored in memory, the more likely it is to belong to the prototype's category

- Often involves ignoring the **base-rate rule**: if something is chosen from a set at random, the chances that the thing will be of a particular type are directly proportional to the percentage of that type in the larger set
- Alternatively, people just have trouble understanding descriptions of probabilities.

Availability heuristic: tendency to judge objects or events as more likely, common or frequent if they are easier to retrieve from memory

- Ex: words that start with k vs. words with k in the 3rd position?
    - People think there are more words that start with k, but this is wrong! It is just easier to retrieve from memory words starting with k than words that have k in the 3rd position.
- Expt: Redelmeier et al. (2003): colonoscopy → patients judged the overall pain of the procedure on the basis of the most available part of the procedure (most recent part)

Many people think that emotion clouds reasoning and distorts our ability to be object. But in fact, researchers have found that sometimes emotions can actually help reasoning.

9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

- Having a hunch (correlated with skin-conductance responses) helps in gambling games??

Other times, emotions (ex: fear, anger) can disrupt reasoning.

- If you are agitated, working memory is disrupted; reasoning is more difficult to accomplish

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INTELLIGENCE: the ability to reason and solve problems well and to understand and learn complex material
- Depends on ability to adapt to environment?
- Performing quickly *and* accurately

BINET & SIMON: intelligence test as an objective way to identify children in public schools who needed extra classroom help
- Variety of tasks – copy a drawing, repeat numbers, recognize coins / make change, etc.
- Performance on tests should reflect educational experiences
- Compared performance relative to "normal" children at various ages to assign *mental age (MA)*
- Children with *mental age* less than *chronological age* were considered slow

TERMAN & WECHSLER: **Wechsler Adult Intelligence Scale**: most widely used intelligence test; consist of both verbal subtests and performance (nonverbal) subtests

4 parts → *see p. 217, Table 2 for WAIS-IV Subtests with Simulated Examples of Questions*
1. Verbal comprehension
2. Perceptual reasoning (nonverbal)
3. Working memory
4. Processing speed (nonverbal; focusing attention to use information quickly)

WILLIAM STERN: developed idea of an intelligence quotient (IQ)
- [(Mental Age) / (Chronological Age)] * 100
- Average = 100
- Problem: mental age does not keep developing forever, chronological age does

Intelligence tests are no longer scored by using the MA/CA ratio. Instead, IQ is computed by comparing a particular person to the average of other people of the same age.
Average is still 100.
How this is done:
- **Standardized Sample**: a representative selection of people, drawn from a carefully defined population
- **Norming**: the process of setting the mean (i.e.: 100) and the standard deviation (degree to which the individual scores can deviate from the mean while still be "average"… ~ 15 points) of a set of test scores, based on results from a standardized sample

Intelligence Quotient (IQ): a score on an intelligence test, originally based on comparing mental age to chronological age, but later based on norms and used as a measure of intelligence

Reliable – produces consistent results
Valid – measures what it is supposed to measure

IQs predict performance in the real world
- Higher IQs = higher GPAs; more success; higher-prestige jobs; earn more money; more stable marriages; stay out of jail
- HOWEVER, not everybody who is successful at work has a high IQ; not all people with high IQs are successful

9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

- Success also depends on: personality traits of conscientiousness and integrity; motivation, ambition, education; culture / values

ANALYZING INTELLIGENCE

Spearman's g Factor

Positive correlations among scores on different types of mental tests indicate the existence of a single underlying intellectual capacity, labeled "g" for **general factor**.

Factor analysis: a statistical method that uncovers the particular characteristics (factors) that make scores more or less similar; the more similar the scores, the more strongly implicated are shared underlying factors.

Specific factor: "s" = aspects of performance that are particular to a given kind of processing

- Evidence for s: there is a wide variation in the sizes of the correlations between scores on individual tests

When you perform a task, you are drawing on g as well as on a particular type of ability s, which is specific to the task. Some tasks rely more on *g* than on *s*.

IQ scores depend mostly on *g*; how intelligent you are overall depends on how much of this general intellectual capacity you have.

Thurstone's Primary Mental Abilities

Intelligence consists of 7 separate **primary mental capacities**: fundamental abilities that are the components of intelligence and are distinct from other abilities

Ex: verbal comprehension, spatial visualization

Catelli and Horn – Fluid and Crystallized Intelligence

Fluid Intelligence: underlies the creation of novel solutions to problems; ability to reason without relying heavily on previously learned knowledge or procedures

- Ex: ability to reason about novel situations and to solve novel problems; ability to abstract concepts on the basis of new information or procedures; ability to use reasoning that does not depend primarily on learning and acculturation; ability to manipulate abstract concepts, rules, and generalizations and to use logical relations

Crystallized Intelligence: relies on knowing facts and having the ability to use and combine them; relies on using experience and on learned procedures to reason (ex: general skills that have been developed (i.e.: crystallized) from exercising fluid *g* in the past)

- Ex: ability to reason using previously learned procedures; ability to use factual knowledge acquired through education and experience; ability to use reasoning that is based on learning and acculturation; ability to use language to communicate

As we age, crystallized intelligence does not suffer much, but fluid intelligence deteriorates → we still maintain our expertise in an area, but the ability to shift gears quickly to solve new problems tends to decrease.

Two different intelligences develop at different rates during childhood; rely on different brain structures; are not equally heritable.

Different facets of academic achievement are predicted by the 2 forms of intelligence.

Carroll's Three-Stratum of Cognitive Ability

Relations among test scores are neatly structured into a 3-striate hierarchy → top is *g*, next are 8 broad cognitive abilities (which include fluid and crystallized intelligences), and under each of those broad cognitive abilities is a set of narrow abilities.

Each of the broad abilities relies on g, and each of the broad abilities is, in turn, drawn on by narrow abilities.

Performance on any specific task requires factors in all 3 tiers.

Grand synthesis of earlier theories → most widely accepted theory

9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

Faults:
1. Fluid and crystallized intelligence are argued to sit above *g*
2. The middle tier can be boiled down further → quantitative, spatial, verbal abilities

EMOTIONAL INTELLIGENCE: the ability to understand and regulate emotions effectively
Whether you act intelligently depends on how well you understand both your own emotions and the effects your actions have on others.
2 Major Facets:
1. Reasoning, Problem Solving, Learning

4 Branches:
1. *Perceiving emotion* – ability to identify emotions on the basis of perceptual cues
- Ex: noticing that a frown = jealousy
2. *Facilitating thought with emotion* – ability to harness emotional information to enhance thinking
- Ex: thinking through a planned comment and changing it to avoid a rocky outcome
3. *Understanding emotion* – ability to comprehend emotional information about relationships
- Ex: understanding why someone is jealous
4. *Managing emotion* – ability to manage emotions and emotional relationships
- Ex: taking a deep breath before responding calmly, even if you are annoyed

The tests for this facet of EI rely on asking test-takers to make decisions about emotion-laden situations, and the decisions are scored as right or wrong → "objective tests"
- Positively correlated with g, accounts for ~10% of the differences in performance

2. Subjective Experiences and Inclinations

The tests for this facet of EI require test-takers to rate themselves subjectively regarding relevant characteristics, such as their degree of assertiveness, empathy, tolerance for stress, and optimism. There is no right or wrong answer → "subjective tests"
- Almost entirely distinct from g; correlated with some measures of personality

Women score higher than men on some dimensions of EI; minority groups score higher than whites; older people score higher than college students

MULTIPLE INTELLIGENCES

Gardner's Theory of Multiple Intelligences: 8 distinct forms of intelligence, each of which can vary separately for a given individual
1. *Linguistic* – the ability to use language well → journalism, law
2. *Spatial* – the ability to reason well about spatial relations → architecture, surgery
3. *Music* – the ability to compose and understand music → audio engineering, music
4. *Logical-Mathematical* – the ability to manipulate abstract symbols → science, computer programming
5. *Bodily-Kinesthetic* – the ability to plan and understand sequences of movements → dance, sports
6. *Intrapersonal* – the ability to understand yourself → ministry
7. *Interpersonal* – the ability to understand other people and social interactions → politics, teaching
8. *Naturalist* – the ability to observe aspects of the natural environment carefully → forest conservation
9. ??? Existential – the ability to address "the big questions" about existence → philosophy

Support:
- Brain damage often results in the loss of a certain ability while leaving others relatively intact → if abilities can be disrupted independently, then they arise from distinct brain systems… and hence reflect specific types of intelligence
- People learn their first language in a few years, but complex mathematics is not learned so easily → if 2 abilities develop at different rates during childhood, they probably rely on different underlying processes

9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

- Child prodigies in math or music, but average performance in other areas → coexistence of the extraordinary with the ordinary suggests that some intellectual capacities are psychologically distinct from others

Various combinations of forms of intelligence are needed to succeed in different professions. Each person can be characterized by a *profile of intelligences*, which indicates a person's relative strengths and weaknesses regarding the various forms of intelligence.
Problem: different intelligences can't be measured or separated rigidly, so the theory is difficult to test scientifically; Gardner's "intelligences" have more to do with talents and skills

Sternberg's Analytic, Practical, and Creative Intelligences → Triarchic Theory of Successful Intelligence

1. *Analytic Intelligence* – the ability to learn to write clearly, do math, and understand literature; critical for academic performance
2. *Practical Intelligence* – knowing how to do things like fix a car, sew a button; relies on implicit memories; learned responses; skills that guide our actions without our being aware of them; "street" smarts
3. *Creative Intelligence* – ability to formulate novel solutions to problems

IQ is a measure of only analytic intelligence. Practical intelligence is largely distinct from analytic intelligence. Measures of practical intelligence are better predictors of how well someone will do on the job than are standard measures of IQ.
→ highly controversial!!
Although creative intelligence is large distinct from IQ, people do need a certain level of IQ to be able to find creative solutions to problems or to create novel products that have specific uses.
Objections: are talents and skills being treated as "intelligence"?

→ ***See p. 225, Table 6 for a summary of the 6 prominent views about the nature of intelligence***

SMART GENES
Studies have shown that multiple genes contribute to intelligence and do so in different ways.
Ex: a portion of DNA has been found to be associated with one type of spatial ability, but not with *g*; 2 different genes predict performance aspects (but not verbal) of IQ

Genes (Nature) vs. Environment (Nurture)??

- Adoption studies → IQ scores of adopted children compared to adoptive vs. biological relatives; adopted child's IQ correlated more highly with biological mother's IQ score than with adoptive mother's IQ; when child grows up, virtually no correlation remains
- Tests given to twins separated after birth and adopted into different families; correlation of IQs for adult identical twins who were raised apart is higher than both that for fraternal twins and that for nontwin siblings raised together

GENES AFFECT IQ.

- The more genes people have in common, the higher the correlations in IQ.
- Heritability (what proportion of observed variability in a characteristic within a population is caused by inherited factors; not to the proportion of the characteristics that is inherited by an individual!) of IQ = ~ 0.50

The frontal lobes, in particular, appear to be the regions of the brain with high heritability that plays a key role in IQ. (Frontal lobes are also important for working memory, inhibiting emotional responses, regulating much of the rest of the brain… ?!)

SMART ENVIRONMENTS → *Environment also affects intelligence as assessed by IQ.*

Prenatal Enviornment:
If mother eats a balanced diet, takes vitamins, doesn't drink, smoke, or take drugs, child tends to have higher IQ scores.

Because identical twins must share the same placenta and amniotic sac, they must compete for resources, and inevitably, one twin will be in the favored position and receive more of the nutrients, etc. than the other. Thus, at birth, identical twins have larger disparities in weight and length at birth than do fraternal twins, so their early environment may make them less similar than their genes would dictate.

Adoptive Households:
Separated twins are often placed in similar households.
In a study that mathematically corrected for the small variations among adopting families, the estimated effects of environment on IQ was 57%, which is greater than the usual estimate for the effects of genes.

Microenvironments:
Your genes help shape your **microenvironment**: the environment created by a person's own presence, which depends partly on appearance and behavior, which then may affect IQ.

People select aspects of the environment that appeal to them – perhaps because of personality characteristics that are partly regulated by genes. People who share the same personality traits may gravitate towards similar environments.
As people age, they are increasingly able to select their environments, and genetically influenced characteristics, such as temperament, lead people to select certain environments over others.

- Helps explain why effects of *shared family environment* (aspects of the family setting that are present for all siblings in a household) on IQ wear off as we grow older.

Genes may have some of their effects indirectly, by causing a person to affect or select the environment.

GROUP DIFFERENCES IN INTELLIGENCE
The genetic contribution to intelligence within a given group cannot say anything about possible genetic differences between groups.

Turkheimer et al. (2003) – compared IQs of identical and fraternal twins from both affluent and impoverished neighborhoods.

- Affluent twins: genetics accounted for the bulk of the variations in IQs (heritability ~ 72%); shared environment accounted for little variation (~15%)
- Impoverished twins: shared environment accounted for the bulk of the variations in IQ (58%); heritability accounted for little variation (10%)

→ Clear evidence that environment plays a more important role in affecting IQ scores for impoverished children than do genes

Heritability estimates only tells us about the effects of genes in a *certain environment*; they say nothing about the possible effects of genes in *other environments*. Heritability only tells you about the effects of genes in a certain environment, but it says nothing about their possible effects in other environments.

Race Differences (highly controversial)
Some ethnic groups have lower IQ scores than others.
Asian Americas > White Americans > Mexican Americans > Black Americans
Disparity in test scores reflects

- **test bias**: features of test items or design that lead a particular group to perform well or poorly and that thus invalidate the test
- Test anxiety → people with different backgrounds are more or less comfortable taking various sorts of tests
- Environmental differences; people who are better off tend to score higher on IQ tests (in American society, whites are generally wealthier than blacks)
- Inferior schooling

- The microenvironment (dark skin is a cue that elicits some kind of negative treatment from the white majority)

Group differences do not necessarily apply to any particular individual – plenty of Black Americans have higher IQs than plenty of Whites.

SEX DIFFERENCES IN IQ
Males are better at some tasks than females, vice versa.
Males tend to be better than females at tasks that require spatial reasoning, whereas females tend to be better than males at tasks that require verbal reasoning.

Factors that can account for these sex differences:

- Evolutionary accounts (for differences in spatial ability)
  - Men go out hunting (required navigation); women stayed home, picked berries, weaved baskets, tended children; men with better spatial ability would have been more successful and would be able to produce more children to inherit the relevant genes
  - Problem: women's tasks also have some spatial aspects!
- Biological factors – effects of sex hormones
  - Women receiving massive doses of male hormones saw increased spatial abilities, decreased verbal abilities
  - Level of male hormones affects spatial abilities in men, etc.
  - Problem: relationships between hormone levels and behavior are not always found; effects observed depend on a variety of other currently unknown factors
- Health differences
  - Men tend to exercise more than women
  - Women tend to have more depressive symptoms than men
  - When health factors were controlled statistically, male's superior performance on certain cognitive tasks disappeared, female superior performance on other tasks actually became greater.
  - Health differences can account for some things, but not others!
- Sociological factors – how boys and girls are expected to behave in our society
  - Boys and girls are encouraged to take part in "sex appropriate" activities (if you don't use it, you lose it… and girls have not been encouraged to go climb trees or play ball)
  - Differences in how boys / girls are treated
  - Remember: there are girls that are better than boys at spatial reasoning, some boys are better than girls at verbal reasoning (individual differences still exist despite general trends)

MENTAL RETARDATION
Mentally retarded: people who have an IQ of 70 or less and significant limitations in at least 2 aspects of everyday life (ex: communication, self-care, self-direction) since childhood
≠ inability to learn
Results when the brain fails to develop properly → from both genetic and environmental factors

Genetic Influences
Down Syndrome: type of MR that results from the creation of an extra chromosome during conception; it is a genetic problem but not inherited; average IQ = 55, but degree of MR varies widely
Fragile X Syndrome: type of MR that affects the X chromosome (mutation makes it likely to break); it is both genetic and inherited (gets worse as it is passed down the generations)

Environmental Influences
Fetal Alcohol Syndrome: a condition that includes MR and is caused by excessive drinking of alcohol by the mother during pregnancy
Pregnant women with malnutrition, rubella, diabetes, HIV infection, lots of X rays, infections, taking antibiotics / aspirin → more likely to have child born with MR

9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 6 – *Language, Thinking, and Intelligence: What Humans Do Best*

Other hazards: premature birth; low birth weight; chicken pox / measles → brain damage; ingesting lead, mercury, poisons; malnutrition, unsanitary conditions / inadequate healthcare

In the last century, MR has been on the decline. Vaccines and other medical treatments greatly reduced the incidence of MR that arises from childhood diseases.

THE GIFTED

Gifted: people who have IQs at least 3 standard deviations above the mean (WAIS-IV score > 145)

- Gifted boys tend to have lower testosterone levels than nongifted boys, whereas gifted girls may actually have higher amounts of testosterone than nongifted girls.
- Not always biological factors!
    - Boys with lower testosterone probably spent more time reading (contributes to intellectual development)
- *Efficient Processing* – gifted children engage in the same kinds of processing as average children, but simply do it more effectively
    - Support: gifted children grow up to be ordinary adults.
- *Different processes* – the cognitive processes of gifted children are qualitatively different

Prodigies: children who demonstrate immense talent in a particular area, such as music or mathematics, but who may have only average abilities in other areas

Gifted children are at times socially awkward, tend to be solitary, introverted, twice the rate of emotional and social problems as nongifted children

People who are not gifted as children can still make extraordinary contributions to society.

Creativity: the ability to produce something original of high quality or to devise an effective new way of solving a problem; the ability to recognize and develop a novel approach; the ability to consider a problem from multiple angles and to change points of view repeatedly; the ability to develop a simple idea in different ways

- Involves interplay between 2 types of thinking:
    - *Divergent thinking* – exploring a variety of approaches to a solution
    - *Convergent thinking* – pruning down the possibilities, refining at least one to the point where it can be used

Relies on a 2 step process: generate a variety of possible solutions to a problem, then interpret and select among them

<u>(Cognitive / Personal) Characteristics of Creative People</u>

- Keep options open
- Don't make snap decisions about the likely outcome of an effort
- Good at seeing a problem from a new vantage point
- Are flexible and able to reorganize information
- Think in terms of analogies
- Tend to have high intelligence, wide interests, don't go with traditional ways of thinking, have high self-esteem, like to work hard
- Highly motivated and persistent
- Mental instability?
    - Bipolar disorder promotes creativity?

Differences in creativity are not strongly related to genetic differences.
Shared aspects of the home strongly affect creativity.

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