Marcel, age 14 years

- If space is always expanding, but space is everything, what is space expanding into?

5 year olds reactions to Challenger tragedy

- People go to space to find stars and foods for people
- People shouldn’t go in the sky
- The rocket died
- Somebody shouldda moved the clouds.
- Even my dad said it was sad
- Does this mean we don’t get space lesson

Children are not little adults
Piaget’s Theory of cognitive development
Assimilation

Accommodation

Example of Equilibration

• Heavy things are big and light things are small
Example of Equilibration

Introduce a big cardboard box needs to change ideas

Stages of Cognitive Development

- Stage theory
- Stages are invariant and universal
- Stages are in a response to biological and environmental forces
- 4 stages:
  - Sensorimotor
  - Preoperational
  - Concrete operational
  - Formal operational

Sensorimotor:
birth to 2 years of age

- Investigate their world through their senses (sight, hearing, etc.)
- Develop object permanence: belief that objects and people do not disappear merely because they are out of sight.

http://www.youtube.com/watch?v=NjBh9ld_yIo&NR=1
Preoperational Stage:  
2 to 7 years of age

- Can use one thing to represent another (e.g., piece of wood can represent a boat)
- Emerging use of symbolism is seen in expanding language abilities.
- Egocentric
- Cannot understand conservation: quantities remain the same despite change in their appearance.

Concrete Operational Stage:  
7 - 12 years of age

- Develop ability to conserve.
- Understand the world on a concrete, tangible level.
- Can’t understand political cartoons, sayings such as “you can lead a horse to water, but you can’t make him drink”
Formal Operational Stage: 12 years of age and up

- Develop ability to deal with abstractions and engage in scientific logic.
- Think about thinking (why they hold a particular position).
- Can consider hypotheses, deal with future orientation.
- [http://www.youtube.com/watch?v=lw36PpYPZM](http://www.youtube.com/watch?v=lw36PpYPZM)
- [http://youtu.be/zJdcXA1KH8](http://youtu.be/zJdcXA1KH8)

What can adolescents do?

1. Adolescents are better able than children to think about what is possible

Changes in Cognition

- Thinking about Possibilities
  - Ways in which their lives might be affected by different career choices
  - Ability to move easily between the specific and the abstract and to generate alternative possibilities. Study of mathematics.
  - Development of deductive reasoning.
Inductive reasoning - all ages can do

- Conclusion based on accumulated evidence
  - Kim, John, Julie, Tom, Liz and Kendra are hockey players
  - Kim, John, Julie, Tom, Liz and Kendra all wear a mouth guard
  - Do all hockey players wear a mouth guard?

Deductive reasoning - emerges in adolescence

- Draw logical conclusions from a general set of premises
  - All hockey players wear mouth guards
  - Kim is a hockey player
  - Does Kim wear a mouth guard?

- http://youtu.be/zjJdcXA1KH8

Engage in hypothetical thinking.
Ability to evaluate hypotheses

- John decides to make a cake, but he ran out of some ingredients.
  - Margarine instead of butter
  - Honey instead of sugar
  - Bran instead of flour
Forming of hypothesis

- The cake is great, very moist. John thought the reason was the honey. He thought that the type of shortening or flour didn’t matter.

What should he do to prove his point?

(a) He can bake the cake, but use sugar instead of honey, and still use the margarine and the whole-wheat flour.

(b) He can bake the cake, but use sugar, butter and regular flour.

(c) He bake the cake again still using the honey, but this time using butter and regular white flour.
What can adolescents do?

1. Adolescents are better able than children to think about what is possible
2. Adolescents are better able to think about abstract things.

Thinking about abstract concepts

– Ability to comprehend higher-order abstract logic inherent in puns, proverbs, metaphors, and analogies
– The growth of social thinking (social cognition) during adolescence is directly related to the young person’s improving ability to think abstractly. Can think about personal relationships, politics, philosophy, religion and morality, friendships, faith, democracy, fairness and honesty.

Idealism

• Can grasp what *is* and what *might be*
• Become critical of society and parents
• Become impatient with those who disagree
• Often champion the underdog
Hypocrisy

• What they say and what they do differs
  – Can’t translate general principles into concrete actions
• Pretending to be something you are not
  – Often pressured to do so

What can adolescents do?
1. Adolescents are better able than children to think about what is possible
2. Adolescents are better able to think about abstract things.
3. Adolescents think more about the process of thinking itself.

Metacognition-thinking about thinking
– Monitoring one’s own cognitive activity during the process of thinking
– Increased introspection, selfconsciousness, and intellectualization, Also a point where adolescents can get ‘lost in thought’
– Adolescent egocentrism→imaginary audience and personal fable
Egocentrism

• Two components
  – Personal Fable
    • Belief that one is special and unique. Can lead to:
    • Anguish: no one can understand me, no one has ever felt this bad
    • Hopes for a unique personal destiny: movie or rock star, star athlete
    • Invulnerability: bad things won’t happen to me

Egocentrism

• Increased introspection can lead to egocentrism
  – Imaginary Audience
    • Imagine that others are thinking about, evaluating you (especially appearance)

What can adolescents do?

1. Adolescents are better able than children to think about what is possible
2. Adolescents are better able to think about abstract things.
3. Adolescents think more about the process of thinking itself.
4. Adolescents thinking, compared to children’s, is more often multidimensional, rather than limited to a single issue.
Thinking in Multiple Dimensions

- Thinking about different dimensions simultaneously
- Probability, personality dimensions,
- sarcasm
- South Park, Beavis and Butthead, Simpsons, Family Guy

Pseudostupidity

- Treat even simple problems as if they were complex
- Get lost in multitude of choices
- Due to lack of experience

What can adolescents do?

1. Adolescents are better able than children to think about what is possible
2. Adolescents are better able to think about abstract things.
3. Adolescents think more about the process of thinking itself.
4. Adolescents thinking, compared to children’s, is more often multidimensional, rather than limited to a single issue.
5. Adolescents are more likely than children to see things as relative, rather than absolutes
Adolescent Relativism
- Ability to see things as relative rather than simply black and white → skepticism
- They may come to feel as if everything is uncertain, or that no knowledge is completely reliable
  • Ability to see things as relative rather than as absolute
  • Skepticism becomes common
  • Everything may seem uncertain
  • No knowledge seems completely reliable

Piaget on Reasoning of Adolescents
- Adolescents begin to apply propositional logic (applying principles of logic to abstract and social reasoning)
- They begin to approach problems with systematic strategies:
  - E.g., holding all but 1 variable constant
  - E.g., systematically test all possibilities

Characteristics of Formal Operational Thought

<table>
<thead>
<tr>
<th>Idealistic</th>
<th>Logical</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents often think about what is possible. They think about ideal characteristics of themselves, others, and the world.</td>
<td>Adolescents begin to think more like scientists, devising plans to solve problems and systematically testing solutions. Hypothetical–Deductive Reasoning (Piaget)</td>
<td>Adolescents think more abstractly than children. Formal operational thinkers can solve abstract algebraic equations, for example.</td>
</tr>
</tbody>
</table>
Are Formal Operations Universal?

- Not all adolescents or adults use formal operations
  - By 8th grade, only 1/3 of teens use them
  - On tests of formal operations, roughly 40-60% of teens and adults do not use them
- Reasons for variation:
  - Requires effort
  - Varies with formal education, cultural norms
  - Within person variability: may be used more with some tasks than others

Intelligence Tests

- Alfred Binet-French psychologist
  - Help the Parisian school board predict which children were in need of special schooling
  - Now referred to a IQ test-standardized way of assessing a person's current mental ability
    - Diagnoses learning disabilities, identify strengths and weaknesses
    - Determine whether a person is mentally retarded
    - Identify gifted children
    - Part of neurological evaluations (deterioration over time)

What do they measure?

- Intelligence defined as:
  - Language skills
  - Visual spatial skills
  - Attention and concentration
  - Speed of processing
- Standardized
  - 100 is the mean 15 is standard deviation
  - 65% of the population receive scores between 85 and 115
  - Below 70 subaverage ~mentally retarded 2.5% of pop
  - Above 130 intellectually gifted 2.5% of pop
<table>
<thead>
<tr>
<th>Classification</th>
<th>IQ Range</th>
<th>Percent Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Superior</td>
<td>128 and over</td>
<td>2.2</td>
</tr>
<tr>
<td>Superior</td>
<td>120-127</td>
<td>6.7</td>
</tr>
<tr>
<td>Bright or High Normal</td>
<td>111-119</td>
<td>16.1</td>
</tr>
<tr>
<td>Average</td>
<td>91-110</td>
<td>50</td>
</tr>
<tr>
<td>Dull or Low Normal</td>
<td>80-90</td>
<td>16.1</td>
</tr>
<tr>
<td>Borderline</td>
<td>66-79</td>
<td>6.7</td>
</tr>
<tr>
<td>Defective</td>
<td>65 and below</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Stability of IQ

- Very stable
- Increase during adolescence (people become smarter as they get older)
- Intelligence test scores become increasingly stable during childhood (age 6 or 7) and are remarkably stable during adolescence.
Sternberg “Triarchic” Theory

- Componential intelligence: ability to acquire, store and process information (IQ Tests)
- Experiential intelligence: abilities to use intuition and creativity
- Contextual intelligence: “street smarts”

Gardner’s Theory of Multiple Intelligences

- Verbal-Linguistic
  - Highly developed auditory skills
  - Like reading and writing and work games (i.e., crossword puzzles)
  - Good memory for names, dates and places
  - Good story tellers
  - Learn best by saying and hearing words
  - Poets, writers and people who have to speak a lot in their jobs
- Logical/Mathematical
  - Scientific thinking
  - Like to explore relations and patterns, like to figure out how things work (e.g., problem solving)
  - Love numbers and using logical reasoning
  - Learn best by classifying information, looking for common patterns
  - Scientists, Mathematicians
- Spatial
  - Like to explore spatial relations
  - Like to visualize things
  - Learn best by visualizing things
- Kinesthetic (movement)
  - Like to move things around
  - Like to touch things
  - Learn best by doing things
- Self-reflective
  - Like to think about what they are thinking
  - Like to read about what they are thinking
  - Learn best by thinking about what they are thinking
- Interpersonal
  - Like to interact with other people
  - Like to discuss things with other people
  - Learn best by interacting with other people
- Musical
  - Like to listen to music
  - Like to make music
  - Learn best by listening to music and making music
Gardner's Types of Intelligence

Musical
- Sensitive to sound
- Enjoy music and listen to music all the time even when studying or reading
- Good at pitch and rhythm
- Singers, conductors and composers

Visual-Spatial
- Work well with maps, charts, diagrams, visual arts
- Like to design and create things
- Learn best by seeing information especially pictures, diagrams, charts
- Sculptors, surgeons, engineers

Gardner's Types of Intelligence

Bodily-Kinesthetic
- Use bodily sensations to get information
- Good balance, coordination and are good with their hands
- Learn best through physical and hands-on activities
- Carpenters, mechanics, dancers, gymnasts, juggles, swimmers

Intrapersonal
- Aware of personal strengths, weaknesses and feelings.
- Independent, determined, self-confident and highly motivated
- Work best in independent study
- Entrepreneurs, philosophers, psychologists

Gardner's Types of Intelligence

Interpersonal
- Good people skills
- Like being around people, talking to people and social activities
- Empathy for feelings of others
- Learn by relating, sharing and working in groups
- Politicians, salespeople, counselors, consultants and teachers
Changes in Social Cognition

- Thinking about people, thinking about social relationships, thinking about social institutions.
- Changes in:
  - Impression formation (how individuals form and organize judgments about other individuals)
  - Social perspective taking, examines how and how accurately people make assessments about the thoughts and feelings of others

Adolescent Thinking: The Information-Processing View

- Question of Interest
  - What is it about the ways that adolescents think about things that make them better problem solvers than children?
- Techniques used to write computer programs can help understand human reasoning processes

Information-Processing View: Areas of improvement during adolescence

1. Selective attention and divided attention
2. Working memory and long term memory
3. Processing speed
4. Organization
5. Metacognition
Impression of others

Impressions are global, egocentric, concrete, disorganized and haphazard

Impressions are differentiated, objective, and organized into a coherent whole

-Gender, age, Interests, personality characteristics,

Physical characteristics or personal possessions

Impressions are personal, subject to disagreement
Motives, attitudes
Feelings of others,
Implicit Personality Theory-why people are the way they are.

Adolescent thinking in context

• Adolescent Risk-Taking
  – Risk-taking seems to be more common among males than females, but this gender gap has been narrowing over time
  – Adolescents are more likely to feel invulnerable
Risk-Taking

- Risk-taking is more common among males than females
  - This gender gap has been narrowing over time
- Decision making theory: Rational process-costs and benefits analysis
  - 1. identifying alternative choices
  - 2. identifying the consequences of each choice
  - 3. evaluate costs and benefits of consequence
  - 4. assessing likelihood of each consequence
  - 5. combining all the information according to decision rule

**ADOLESCENT THINKING IN CONTEXT**

- Adolescent Thinking in the Classroom
  - American youth have difficulty thinking in the sophisticated ways that our theories and research suggest they ought to be capable of
  - Schools can and should teach adolescents ways of focusing attention, improving short-and long-term memory, organizing information, and monitoring thought processes
The Adolescent Brain

- Research is conducted using fMRI, PET, and DTI scans
- Brain maturation in adolescence is linked to behavioral, emotional, and cognitive development during this period (Keating, 2004)

What Changes in The Brain?

- Among the most important brain changes to take place at adolescence:
  - The prefrontal cortex
  - The limbic system

The Adolescent Brain

- Changes in the prefrontal cortex (PFC) improve efficiency of info-processing:
  - Synaptic “pruning”
  - Myelination
- Changes in levels of neurotransmitters in the limbic system affect reward sensitivity:
  - Dopamine
Maturation of the Prefrontal Cortex

- **Full Maturation**
  - Sometime between adolescence and early adulthood
- **Dorsolateral prefrontal cortex**
  - Important for planning ahead
- **V ventromedial prefrontal cortex**
  - Important for gut-level, intuitive decision making
Intellectual Abilities that Decline in Adolescence

- Brain regions involved in language acquisition grow rapidly in preadolescence
- These regions stop growing at puberty
- Language-learning more difficult during adolescence than childhood