Adolescence 12th edition Steinberg Solutions Manual

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CHAPTER 2
Cognitive Transitions

Learning Objectives

1. Describe the five main changes in thinking that characterize the transition from childhood to adolescence.

2. Provide examples of two different aspects of adolescent egocentrism.

3. Discuss the Piagetian and information-processing perspectives as they relate to the development of adolescent cognition.

4. Describe the four areas of information processing where improvement occurs during adolescence.

5. Describe the changes in brain function and brain structure during adolescence that may be linked to behavioral, emotional, and cognitive development.

6. Describe the measurement of IQ and its improvement during adolescence. Also address the issue of individual differences in IQ and IQ assessment.

7. Describe the context of adolescent thinking, the four most common areas of social cognition research, and the changes in social cognition during adolescence.

8. Examine the role that decision making plays in adolescent risk taking and compare it to that of adults.

9. Explain why many common approaches to reducing adolescent risk taking are unsuccessful and provide alternative methods that might be successful.

Key Terms

adult plasticity
autobiographical memory
behavioral decision theory
brain function
brain structure
cognitive-developmental view
concrete operations
deductive reasoning
developmental plasticity
diffusion tensor imaging (DTI)
divided attention
dopamine
electroencephalography (EEG)
event-related potentials (ERP)
executive function
formal operations
functional connectivity
functional magnetic resonance imaging (fMRI)
imaginary audience
information-processing perspective
limbic system
long-term memory
mentalizing
metacognition
myelination
neurons
neurotransmitters
personal fable
plasticity
prefrontal cortex
preoperational period
reminiscence bump
response inhibition
scaffolding
selective attention
sensation seeking
sensorimotor period
serotonin

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social cognition
social conventions
synapse
synaptic pruning
theory of mind
working memory
zone of proximal development

Notable Changes from the Last Edition

- Thorough update of all content (more than 90 new citations)
- Expanded discussion of memory during adolescence and the "reminiscence bump"
- Expanded material on the basics of brain development
- Condensed discussion of intelligence
- Greatly expanded discussion of structural and functional changes in the adolescent brain
- Added discussion of brain plasticity in adolescence and brain development in young adulthood
- Expansion of material on "the social brain"
- Expanded discussion of risk taking in adolescence

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Chapter Overview

I. CHANGES IN COGNITION

A. Adolescents not only know more than children but are now able to think in ways that are more advanced, more efficient, and generally more effective.

B. There are five chief ways in which adolescents' thinking differs from that of children: Adolescents are better at thinking about possibilities, abstract concepts, and the process of thinking itself. They also think more multidimensionally and are able to think in relative (as opposed to absolute) terms.

C. *Thinking About Possibilities:* Whereas children's thinking is oriented to concrete events that they can directly observe, adolescents have the ability to think about what might be. This allows adolescents to think "counterfactually"—to think not only about how things actually are but to think about what might have been. Related to this new ability is deductive reasoning (in which one draws logical conclusions based on premises) as well as hypothetical thinking (thinking that involves "if-then" statements).

D. *Thinking About Abstract Concepts:* A second notable characteristic of adolescent thinking is the ability to understand abstract, conceptually based relationships and concepts. This ability underlies the adolescent's interest in topics such as interpersonal relationships, politics, philosophy, religion, and morality.

E. *Thinking About Thinking:* Metacognition, the ability to think about thinking, permits adolescents to think about the strategies they use to solve problems and to think about their own thoughts and feelings. Not only do adolescents "manage" their thinking more than children do, but they also are better able to explain how they do it. Being able to introspect may lead to periods of extreme self-absorption—referred to as "adolescent egocentrism." Adolescent egocentrism results in two distinct problems in thinking that help explain some of the seemingly odd beliefs and behaviors of teenagers. The first, the imaginary audience, comes from having such a heightened sense of self-consciousness that you imagine that your behavior is the focus of everyone else's attention. A second problem resulting from adolescent egocentrism is called the personal fable: the belief that you are so unique that what happens to others will not happen to you. These personal fables can cause adolescents to feel invulnerable and lead to risky behavior based on the belief that bad things only happen to others. Researchers have found it hard to document that these phenomena are specific to adolescents. In fact, certain aspects of "adolescent" egocentrism may persist throughout adulthood.

F. *Thinking in Multiple Dimensions:* Children tend to think about things one aspect at a time, but adolescents can consider several dimensions of a situation simultaneously. This allows adolescents to think in more sophisticated ways, especially in the academic and social domains. In addition, thinking in multiple dimensions helps provide a new understanding and appreciation of things such as sarcasm, satire, and metaphor.

G. *Adolescent Relativism:* Children tend to see things in absolute terms: either black or white. Adolescent thinking is characterized by the ability to see that situations are not just good or bad but rather can be interpreted in many different ways (relativism). The ability to question others' assertions and look for hidden agendas may promote skepticism and the rejection of "facts" as absolute truths.

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II. THEORETICAL PERSPECTIVES ON ADOLESCENT THINKING

A. Two especially important theoretical viewpoints addressing the nature of cognitive development are the Piagetian perspective and the information-processing perspective.

B. *The Piagetian View of Adolescent Thinking:* Theorists who adhere to the Piagetian approach take a cognitive-developmental view of intellectual development and argue that cognitive development proceeds stepwise through a fixed series of discrete stages (sensorimotor, preoperational, concrete operations, formal operations), that adolescent thinking is qualitatively different from the type of thinking that children do, and that during adolescence individuals develop a special type of thinking—"formal operations"—that they use across a variety of situations.

C. Piagetian theorists believe that abstract logical reasoning is the chief feature that differentiates adolescent thinking from that of children. Formal operational thought, which is similar to deductive reasoning, provides a logical framework for the young adult on which to organize the range of possibilities and the likelihood of outcomes for both concrete and abstract situations. It is important to differentiate between what adolescents are capable of (competence) and what they actually do (performance). Studies indicate that gaps between individuals' logical reasoning abilities and their actual use of logical reasoning in everyday situations are very large, with everyday decision making fraught with logical errors that cannot be explained by cognitive incompetence. Although Piaget originally thought formal operations developed in a stagelike fashion, more recent research suggests that these skills develop more gradually and continuously through adolescence and beyond.

D. *The Information-Processing View of Adolescent Thinking:* Information-processing researchers investigate which specific aspects of cognition contribute to the cognitive changes characteristic of adolescence and the transition to adulthood. Information-processing researchers have focused on five areas in which improvement occurs during adolescence: attention, memory, processing speed, and organization. Changes that information-processing theorists observe in adolescents include advances in both selective and divided attention (as well as improvements in the ability to inhibit unwanted responses), increases in working memory and long-term memory, stabilization of early autobiographical memories, an increase in the speed of information processing, improvement in organizational strategies, and improvement in knowledge about their own thinking processes. A phenomenon called the reminiscence bump ensures that adults' memories of adolescence are clearer and more vivid than those from other times of life. This is because in adolescence, ordinary events trigger stronger emotions. Basic information-processing skills are often mature by age 15, but development of more advanced abilities may not happen until the mid-20s.

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III. THE ADOLESCENT BRAIN

A. *Brain Imaging Techniques:* There have been many improvements in the methods used to study brain maturation during adolescence (such as studies of brain growth and development in other animals, studies of changes in brain chemistry in human and nonhuman species, and postmortem studies of brain anatomy). However, the most notable contribution to our understanding of what takes place in the brain during adolescence has come from studies using various noninvasive imaging techniques. These include fMRI (functional magnetic resonance imaging; studying patterns of activity in various regions of the brain while individuals perform a variety of tasks) and DTI (diffusion tensor imaging; studying the ways in which various regions of the brain are connected and comparing patterns of interconnections among people at different ages). Scientists have also studied age differences in patterns of brain activity using electroencephalography (EEG), which measures electrical activity at different locations on the scalp. Some aspects of brain development in adolescence are reflected in changes in brain structure, and some changes are reflected in brain function.

B. *Are Male and Female Brains Different?* In general, male brains are about 10 percent larger than female brains, but it is unlikely that this difference has any practical significance since brain size has little relation to intelligence. By and large, however, the similarities between males and females in brain structure and function—before, during, and after adolescence—are far more striking than the differences. Differences between sexes in brain structure and function are very small and unlikely to explain differences between males and females in the way they behave or think.

C. *How Your Brain Works:* The brain functions by transmitting electrical signals across circuits that are composed of interconnected cells called neurons. Everything we think, perceive, feel, or do depends on the flow of electrical impulses across the brain's circuits. Neurons do not actually touch, and signals between neurons are sent through the release of chemicals called neurotransmitters. The tiny gap between neuron edges is called a synapse. Neurons and the projections that connect them are called gray matter. White matter is the cells other than neurons that send electrical impulses along brain circuits. It includes myelin, a fatty substance that insulates brain circuits.

D. *The Age of Opportunity:* One of the most exciting new discoveries in neuroscience is that some areas of the brain may be especially malleable, or "plastic," in adolescence—they are more easily shaped, for better or for worse, by experience during adolescence than at any time other than the first few years of life. That's why adolescence has been described as an "age of opportunity."

E. *Why It's Hard for Old Dogs to Learn New Tricks:* There are two types of brain plasticity. Developmental plasticity happens while the brain is being built. Adult plasticity allows humans to learn new things but doesn't fundamentally change the brain the way developmental plasticity does.

F. *Changes in Brain Structure During Adolescence:* During adolescence, the area of the brain that undergoes the most dramatic change is the prefrontal cortex (the region most associated with complex thinking: planning, decision making, controlling impulses, etc.). In the prefrontal cortex, there is extensive synaptic pruning of unnecessary neurons as well as myelination (insulation of the axons of neurons with a white fatty substance), which leads to increased efficiency in information processing. Although scientists initially focused on the decrease in gray matter as the main feature of structure change in

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the brain at adolescence, there has been mounting interest in the importance of the increase in white matter, which reflects improved efficiency of connections within and across brain regions. Improved connectivity between prefrontal cortex and the limbic system leads to improvements in our ability to regulate our emotions, process social information, and coordinate our thoughts and feelings. The structural maturation of the prefrontal cortex is not fully complete until the mid-20s.

G. *Changes in Brain Function During Adolescence:* There are two important changes in brain function involving the prefrontal cortex in adolescence that lead to greater efficiency in information processing: (1) patterns of activation within the prefrontal cortex become more focused and (2) activity in the prefrontal cortex becomes increasingly coordinated with activity in other areas (other portions of the cortex and areas of the limbic system).

H. *Risk and Reward:* Another type of functional change is in regard to the ways the brain is affected by certain neurotransmitters. Changes in neurotransmitters like dopamine (which plays an important role in our experience of reward) and serotonin (which plays an important role in the experience of different moods) make individuals more responsive to stress and rewards. In addition, changes in the limbic system are thought to increase individuals' vulnerability to substance use, depression, and other mental health problems, to increase sensitivity to feeling threatened, and to stimulate risk-taking behaviors. It is important to note that the changes in functioning of the limbic system occur relatively early in adolescence, in contrast to developments in the prefrontal cortex, which are still ongoing in early adulthood. In essence, changes in brain structure and function during adolescence may provoke individuals to seek novelty, reward, and stimulation several years before the complete maturation of the brain systems that regulate judgment, decision making, and impulse control. As such, this gap may account for some of the risk taking we see during the adolescent years.

I. *The Social Brain:* Changes in the brain in early adolescence increase the brain's sensitivity to social cues, like other people's facial expressions, mental states, and behavior. They also intensify adolescents' sensitivity to social evaluation, which is why adolescents are more prone to feel embarrassed than either children or adults. This may be why adolescents are so susceptible to peer pressure. However, not all adolescents are equally skilled at reading social cues.

J. *Implications for Adolescent Behavior:* Just because changes in brain structure are followed by changes in adolescent behavior does not mean that one causes the other. Adolescents' behavior—drug use, alcohol use, or even just practicing the same task repeatedly—affects their brain development. Where we draw the boundary between adolescence and adulthood—at least as far as cognitive development is concerned—should probably depend on why the boundary is being drawn and on what specific abilities are relevant to the behavior in question.

IV. INDIVIDUAL DIFFERENCES IN INTELLIGENCE IN ADOLESCENCE

A. While Piagetian and information-processing researchers are attempting to characterize normative changes in cognitive development and intellectual growth, other researchers have focused on the measurement and assessment of individual differences in mental abilities during adolescence—in particular, differences in intelligence.

B. *The Measurement of IQ:* Standardized intelligence tests, or IQ tests, are often used to study individual differences in cognitive abilities. A variety of tests now exist, including

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the Stanford-Binet, the Wechsler Intelligence Scale for Children, and the Wechsler Adult Intelligence Scale. There is considerable difference of opinion over what intelligence really is, and these tests measure a variety of skills including vocabulary, math skills, memory, and picture completion. Changes in specific aspects of IQ performance during adolescence are correlated with synaptic pruning in brain regions known to play a role in those specific types of learning. Mental abilities assessed by conventional IQ tests increase dramatically through childhood and adolescence, reaching a plateau sometime in mid-to-late adolescence. This argues strongly in favor of educational interventions prior to mid-adolescence; interventions in early childhood, especially, have been shown to improve intellectual performance during adolescence. In addition, research shows that extended schooling during adolescence itself enhances individuals' performance on standardized tests of intelligence.

C. *Culture and Intelligence:* It has been argued that youth learn best when they are stimulated to "reach" a little further intellectually than they can grasp. Vygotsky referred to the difference between what youth could perform alone and what they could perform with help as the zone of proximal development. It is the role of the instructor to generate learning opportunities that challenge the students and require them to reach a bit further toward a more advanced level of performance—a structuring process called *scaffolding*. Encouraging teenagers to learn new things and work harder may cause their brains to retain plasticity for a longer period.

V. ADOLESCENT THINKING IN CONTEXT

A. *Social Cognition in Adolescence:* Social cognition refers to how adolescents think about other people, about interpersonal relationships, and about social institutions. Compared with those of children, adolescents' conceptions of interpersonal relationships are more mature, their understanding of human behavior is more advanced, their ideas about social institutions and organizations are more complex, and their ability to figure out what other people are thinking is far more developed.

B. *Theory of Mind:* During preadolescence and adolescence, individuals develop a more nuanced understanding of other people's personalities and psychological states ("mentalizing" is the ability to understand someone else's mental states). In particular, adolescents develop a more sophisticated *theory of mind,* which is the ability to understand that others have beliefs, intentions, and knowledge that may be different from one's own. Adolescents are also better able to interpret or infer the motives and feelings of others, which may lead to improvements in communication.

C. *Thinking About Social Relationships:* Improvements in mentalizing lead to changes in the way that adolescents think about relationships with peers and parents. All other things being equal, children believe that it is wrong to exclude peers from social activities. With age, however, as adolescents' understanding of group dynamics becomes more sophisticated, they begin to take into account other considerations, like personality, the activity context, and the reason for excluding some individuals but not others. Changes in adolescents' understanding of social relationships also transform their beliefs about authority. Adolescents increasingly distinguish between issues that authority figures have the right to regulate (moral issues, such as whether it is acceptable to steal from someone else) and issues that are viewed as the adolescent's own personal choice (conventional issues, such as how clean a teenager's room needs to be). One main source of conflict between adolescents and their parents involves disagreements over which issues parents have legitimate authority and which they do not. Similar changes occur in adolescents'

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beliefs about their teachers' authority and the authority of groups to dictate how individuals should behave.

D. *Understanding Social Conventions:* The realization that individual perspectives vary, and that people's opinions may differ as a result, leads to changes in the ways that adolescents approach issues regarding social conventions (social norms that guide day-to-day behavior). By early adolescence, conventions often are seen as arbitrary social expectations and, consequently, as insufficient reasons for compliance. Ultimately, adolescents come to see that many social conventions serve an important function in society and help coordinate interactions among people.

E. *Conceptions of Laws, Civil Liberties, and Rights:* Similar to the manner in which adolescents develop a better understanding of relationships between people, they also become more nuanced in the way they think about the relationship between an individual and society. Most research on this area comes from studies of Western, middle-class youth. But even in collectivist cultures, adolescents become increasingly likely to believe that there are some freedoms (e.g., freedom of speech and freedom of religion) that should not be restricted and that there are some situations where it might be wise to curtail individual rights.

F. *Adolescent Risk Taking:* Research on cognitive development during adolescence also has been aimed at understanding the thought processes behind adolescent risk taking. In the real world and on many laboratory tasks of risky decision making, adolescents take more risks than adults. In fact, the main health problems of adolescence are the result of behaviors that can be prevented—behaviors such as substance abuse, reckless driving, and unprotected sex.

G. *Behavioral Decision Theory:* One perspective for understanding this behavior comes from the behavioral decision theory, which suggests that all behaviors can be analyzed as the outcome of a series of five steps. These are identifying alternative choices, identifying the consequences that might follow from each choice, evaluating the costs and benefits of each possible consequence, assessing the likelihood of each possible consequence, and combining all this information according to some decision rule. Research suggests that adolescents make decisions in much the same way that adults do.

H. *Age Differences in Values and Priorities:* Young people sometimes behave in risky ways not because of faulty decision making but because they evaluate the possible consequences of their actions (and the desirability of those consequences) differently than adults do and have different values and priorities. For example, in regard to an individual's decision to try cocaine, an adolescent may put relatively more weight on the social consequences of not trying it, whereas an adult may place relatively more weight on the health risks of trying the drug. Furthermore, adolescents are generally more attuned to potential rewards than adults are, which is consistent with what we know about the changes brought about in the limbic system during puberty.

I. *Emotional and Contextual Influences on Risk Taking:* Studies have shown that adolescents demonstrate adultlike decision making when tested under calm laboratory conditions; however, adolescents' decision-making quality declines when they are emotionally aroused. Adolescents who believe they have nothing to lose are more likely to engage in risky behaviors. Additionally, individuals who are high in sensation seeking or impulsiveness are more likely to engage in various types of risky behaviors than those who are low in these qualities. Access to unsupervised environments and peer pressure

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may enhance the probability that individuals may act impulsively and make bad decisions.

J. *Logic and Intuition:* Two different thinking systems—one that is deliberative and logical and one that is intuitive and gut level—most likely interact to influence behavior. Although the development of logical thinking may differentiate adolescents from children, the continued development of intuitive decision making based on experience is the main change to take place between adolescence and adulthood.

K. *Reducing Adolescent Risk Taking:* The most common approach to reducing adolescent risk taking is through classroom-based education programs that emphasize decision making and peer resistance skills and teach adolescents about the dangers of various activities. However, as adolescents do not seem to be ignorant about the risks of these activities or deficient in the ways in which they make decisions, the evidence that these programs work is very shaky. Possible alternative approaches for reducing adolescent risk taking include limiting adolescents' opportunities to put themselves in risky situations, increasing penalties for engaging in certain risky behavior, and providing safe outlets for "normal" sensation-seeking activities (finding ways to permit adolescents to take risks without putting themselves in a situation in which they can hurt themselves). Not all risk taking is bad.

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Lecture Topics and Supplementary Readings

I. Old Approaches to the Study of Cognitive Development and Intelligence

Many students who have previously taken either Introductory Psychology or another course in developmental psychology will have been exposed to Piaget's stage theory of development. However, most treatments of Piaget provide only an extremely simplified version of this very complex theory. One way of approaching such a lecture is to begin with Piaget's work with Binet and use this to introduce the distinction between psychometric and Piagetian approaches to intelligence. Key to this is the difference between normative and individual difference approaches to intelligence. In addition, it allows you to introduce some basic characteristics of children's intelligence tests. Basic Piagetian concepts such as schemes, equilibration, assimilation, and accommodation also can be introduced and discussed. Students often enjoy a basic introduction to Piaget's phenomenology approach, which can be tied into earlier discussions of paradigms and theories. This lecture also works well with a detailed discussion of the Piagetian origins of Elkind's notions of adolescent egocentrism.

Furth, H. G. (1981). *Piaget and knowledge: Theoretical foundations* (2nd ed.). Chicago: University of Chicago Press.

Muus, R. E. (1996). *Theories of adolescence* (6th ed.). New York: McGraw-Hill.

II. New Approaches to the Study of Cognitive Development

Alternatively, an examination of new developments in the study of cognition can be useful, especially in a class in which most students have already been exposed to the more conventional Piagetian and psychometric approaches. Students may be especially interested in some recent attempts to integrate cognitive-developmental and information-processing approaches, such as that by Robbie Case.

Taking a different track, the integration of neuroscience and cognition has led to fascinating breakthroughs in the study and conceptualization of adolescent intellectual performance. An introduction to this aspect of the field can create a bridge from the biological to the cognitive chapter. This can be especially advantageous if you plan to emphasize the cognitive underpinnings of social and psychosocial change during the rest of the course. The Keating chapter provides a strong introduction to this topic.

Case, R. (1985). *Intellectual development: Birth to adulthood*. New York: Academic Press.

Keating, D. P. (2004). Cognitive and brain development. In R. M. Lerner & L Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 45–84). Hoboken, NJ: John Wiley & Sons.

III. Cognitive Change and Its Impact on Social Cognition

Examining how the cognitive changes of adolescence affect social cognition is an excellent lecture topic. Such a lecture helps students to see how intellectual development affects behavior outside of academic or test situations and, more important, how many psychosocial changes of the period can be traced to cognitive ones. Because Kohlberg's perspective on moral development is discussed in detail in another chapter, it might be better to save this widely used illustration for a later lecture. Instead, one might examine Selman's perspective on role taking, Turiel's perspective on social convention (discussed in the article by Smetana), Elkind's discussion of adolescents' sometimes bizarre social behaviors, and/or the growing literature on person perception. In such a lecture, one could begin with the social or psychosocial phenomenon in question (e.g., role taking) and work backward in trying to tie development in this domain to underlying cognitive changes.

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Demorest, A., Phelps, E., Gardner, H., & Winner, E. (1984). Words speak louder than actions: Understanding deliberately false remarks. *Child Development*, *55*, 1527–1534.

Elkind, D. (1978). Understanding the young adolescent. *Adolescence*, *13*, 127–134.

Kuhn, D. (2009). Adolescent thinking. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Selman, R. (1980). *The growth of interpersonal understanding: Developmental and clinical analyses*. New York: Academic Press.

Smetana, J. G. (1997). Parenting and the development of social knowledge reconceptualized: A social domain analysis. In J. E. Grusec & L. Kuczynski (Eds.), *Parenting and children's internalization of values. A handbook of contemporary theory* (pp. 162–192). New York: John Wiley & Sons.

IV. The Adolescent Brain

Changes in the teenage brain have become a hot topic in research and the media. Because many students need a refresher on basic biology, a brief review of neurons and the structure of the brain is necessary. Once the foundation is set, you can focus on the major changes that occur during the adolescent years. The most interesting aspect of this lecture is to then combine the information on the adolescent brain with the general cognitive material previously discussed. This typically generates a discussion on adolescent risk taking and whether adolescents should be held as accountable as adults for their behavior, given the delayed maturation of the prefrontal cortex. To link this discussion to the real world, you could discuss the importance of taking development into account when dealing with crimes committed by adolescents (a topic that will be covered in detail in Chapter 3).

Anderson, S. (2004). Trajectories of brain development: Point of vulnerability or window of opportunity. *Neuroscience and Biobehavioral Reviews, 27*, 3–18.

Beckman, M. (2004). Crime, culpability, and the adolescent brain. *Science, 305*, 596-9.

Casey, B. J., Giedd, J., & Thomas, K. (2000). Structural and functional brain development and its relation to cognitive development. *Biological Psychology, 54*, 241–257.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences, 1124,* 111–126.

Keating, D. P. (2004). Cognitive and brain development. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 45–84). Hoboken, NJ: John Wiley & Sons.

LeDoux, J. (2002). Emotion, memory, and the brain. *Scientific American,* 62–71.

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Cognitive Sciences, 9*, 69–74.

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Additional Readings to Draw From

Byrnes, J. P. (2003). Cognitive development during adolescence. In G. R. Adams & M. D. Berzonsky (Eds.), *Blackwell handbook of adolescence* (pp. 227–246). Oxford: Blackwell Publishing.

This accessible overview summarizes basic information on adolescent cognitive development, with a special focus on the conditions under which optimal cognitive performance is expressed.

Casey, B. J., Jones, R. M., & Somerville, L. H. (2011). Braking and accelerating of the adolescent brain. *Journal of Research on Adolescence, 21,* 21–33.

Moshman, D. (1998). Cognitive development beyond childhood. In D. Kuhn & R. S. Siegler (Eds.), *Handbook of child psychology,* Vol. 2: *Cognition, language, and perception* (pp. 947–978). New York: Wiley.

This chapter highlights metacognitive changes from childhood to adolescence.

Muus, R. E. (1996). *Theories of adolescence* (6th ed.). New York: McGraw-Hill.

This chapter provides an excellent overview of Piaget, including educational implications of his theory.

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Classroom Activities

I. The Poker Chip Problem

The poker chip problem is an interesting way to begin the topic of cognitive transitions during adolescence. While students are filing into class, write on the board or have on an overhead the following instructions: "Imagine four poker chips (one red, one blue, one yellow, one green). Make as many different combinations of chips, of any number, as you can. Use the notations R, B, Y, & G to record your answers." After about 5 minutes, ask for volunteers to describe how they tackled this problem and what strategies they employed. For example, did they need poker chips to solve this problem? Did they approach the problem haphazardly, or did they generate an abstract system? This exercise not only settles the class down quickly but also allows for an immediate discussion of the cognitive differences between children and adolescents.

II. Imaginary Audience Versus Personal Fable

In order to illustrate Elkind's theory of adolescent egocentrism, provide students with a scenario and ask them to determine whether it relates to the concept of imaginary audience or personal fable, and why. For example:

- Sally is going on a date and has a pimple on the end of her nose. (*imaginary audience*)
- John is arguing with his parents at a restaurant when the girl he likes walks in. (*imaginary audience*)
- Sylvia and Gerald decided to have sex even though they didn't have any birth control. (*personal fable*)
- Molly is having her class picture taken and she just got braces the day before. (*imaginary audience*)
- Elise broke up with her boyfriend and, when her mother tries to comfort her, Elise screams that she just doesn't understand. (*personal fable*)
- Even though Cheryl is known for her reckless driving, Gordon decides to take a ride from her anyway. (*personal fable*)

You also may wish to have students generate their own examples of the imaginary audience phenomenon and personal fable. In addition, students should try to find examples that are common to both adolescents and adults in order to illustrate that these phenomena are not unique to adolescents.

A different twist on this discussion is to discuss how the imaginary audience and personal fable might influence the kinds of choices adolescents make, using decision theory.

III. The Development of Humor and Sarcasm

Yalisove (1978) has noted that the cognitive differences between individuals of various ages should be reflected in the sorts of humor they appreciate most. Riddles popular among young children tend to involve conceptual tricks, whereas language ambiguity is most frequently observed in adolescent humor, and absurdity is most appreciated by adults. As a classroom activity, read a variety of jokes to your class.

Those used by Yalisove include:

- What's black and white and read (red) all over? Answer: A newspaper.
- You call suicide prevention, and they put you on hold.
- Can you jump higher than a 10-foot fence? Answer: Yes, a fence cannot jump.
- What table has no legs but never falls? Answer: The multiplication table.

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Ask students to identify cognitive skills required to understand the humor in the different punch lines (e.g., realizing that words can have two meanings, understanding hypothetical ideas) and to predict the age groups that would find each joke most amusing.

Yalisove, D. (1978). The effect of riddle structure on children's comprehension of riddles. *Developmental Psychology, 14*, 173–180.

IV. Changes in Information Processing

In order to clarify for your students the information-processing abilities that change during adolescence, have your students reflect on their own information-processing abilities and how they have changed from high school to the present. To facilitate this exercise, have students complete the handout that appears on the next page. This handout can be completed in class or as a homework assignment in preparation for coverage of this material in class. If used as a class exercise, students may benefit from small group discussions of the general changes that happen in each area before they complete the exercise.

Changes in Information Processing

Directions: Think back to your freshman or sophomore year in high school. List examples of your information-processing abilities in each of the areas indicated in the table below. When finished with these reflections, list the information-processing abilities you currently use. Are the changes in your thinking similar to those changes experienced by most adolescents? How so?

Information-Processing Ability	High School Processing	College Processing
Attention (selective & divided)		
Memory (working & long-term)		
Speed of information processing		

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Organizational strategies		
Knowledge about own thinking		

V. Playing Games

Students often have trouble understanding how much their cognitive capabilities have changed. One way of demonstrating this is to look at games designed for children of different ages and analyze the cognitive capabilities required for them. Good examples include *Candyland* or *Chutes and Ladders* for young children, *Monopoly Junior, Trouble,* or checkers for elementary schoolchildren, and games such as chess, *Monopoly,* or *Risk* for adolescents. Alternatively, compare card games like *Go Fish*¸ *Pokémon,* and *Magic: The Gathering*.

Bring the games into the classroom, and have students play them for 5 minutes or so. You will be amazed at how quickly students are bored with *Candyland!* Then have them discuss the skills needed and compare them across ages. One efficient way to do this is to have groups of three describe their game in detail (a list of potential dimensions can help). Then create new groups that each have a member describing a preschool game, a member describing an elementary school game, and a member describing an adolescent game. They should then analyze the different cognitive demands. You will find that games for very young children are often color coded and do not require much counting. More advanced games require counting but allow no decision making. (Preschool games seem to rely entirely on chance, so that children can win against their parents.) You then move to games with limited strategy choices but a high degree of chance. Finally, adolescent games require a great deal of strategy and multidimensional and hypothetical thinking.

If your class is too big to do this in groups, a comparison of *Monopoly Junior* and *Monopoly* can be done in lecture format, bringing out many of these points. You might start such a lecture by having students do a short, 1-minute essay describing winning strategies for *Monopoly.*

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Resources Available in Connect

The following are a selection of the videos and resources available for Steinberg, *Adolescence,* 12e in Connect.

Chapter	Resource Title	Type
2	Piaget's Formal Operational Substage, Adolescence	Milestones Video
2	Adolescent Perspectives on Thinking and Memory	Milestones Video
2	Critical Thinking, Adolescence	Milestones Video
2	Early Adulthood Perspectives on Thinking and Memory	Milestones Video

Web Resources

National Institute of Mental Health (NIMH) – The Teen Brain: 6 Things to Know:
https://www.nimh.nih.gov/health/publications/the-teen-brain-6-things-to-know/index.shtml

Film and Video List

Adolescence: A Case Study (CRM/McGraw-Hill Films, 1978), 20 minutes
Shows the relationship between improved mental abilities and changes in adolescent psychosocial development.

Adolescent Cognition: Thinking in a New Key (Insight Media, 2004), 30 minutes
Explores the works of Piaget, Erikson, and Goffman while addressing the cognitive changes that occur in adolescence.

Inside the Teenage Brain (PBS, 2002), 57 minutes
Explores what happens inside the brain during adolescence in an attempt to explain why adolescents behave the way they do.

Piaget's Developmental Theory: An Introduction (Davidson Films, 1989), 25 minutes
Using both archival photographs of Dr. Piaget and footage of Dr. Elkind conducting interviews with children of varying ages, this film presents an overview of Piaget's developmental theory, its scope, and content.

The Teenage Brain: A Work in Progress (Insight Media, 2007), 43 minutes
Examines the social, emotional, cognitive, and linguistic developments that occur throughout the teenage years and shows how they influence the actions and attitudes of teenagers. It looks at the ways in which adolescents' frontal lobes differ from those of mature adults and considers the effects of stress and sleep on brain development.

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Outside Activities

I. Developmental Shifts in Understanding Humor and Metaphor

This activity may be used to prepare students for a lecture (or the classroom activity) on developmental changes in humor. Have students collect jokes from children of various ages (e.g., first graders, fifth graders, eighth graders, and twelfth graders) and have them ask why each joke is funny. The results can be used as the basis of a class discussion, as outlined previously.

II. A Comparison of Intelligence Tests for Children and Adolescents

Intelligence tests are controversial. Nevertheless, the use of intelligence tests is a continuing practice by school psychologists and other developmental specialists. This activity involves students reviewing and rating intelligence tests for children and adolescents.

The Activity:

Instructors should cover general course material on intelligence and intelligence testing in infancy, childhood, and adolescence before conducting this activity. Students will find and read reviews of intelligence tests for infants, children, and adolescents using library resources about psychological tests. Students will write a report (five to seven pages if students follow the full procedure below; fewer if you have students engage in only a subset of the activity) summarizing information about certain tests and comparing the tests reviewed. Comparisons must be based on information reviewed as well as course material on intelligence tests for various age groups.

Materials:

Students will visit the library and locate the most recent edition of *The Mental Measurements Yearbook* or *Tests in Print,* which contains information on psychological tests. A psychology reference librarian may be helpful in this regard. Students will then review information on various intelligence tests and write a report comparing them.

Procedures:

1. Before students conduct this activity, they should review course material on intelligence across developmental groups and intelligence testing in particular. They should be familiar with some tests and understand concepts like reliability and validity and norm groups. We recommend that students conduct this activity individually, but instructors may have students work on this in small groups if desired.

2. Students will visit the library and use resources, such as *The Mental Measurements Yearbook* or *Tests in Print,* which contain information on psychological tests to conduct this activity. They should read reviews of at least two intelligence tests for infants, two for children, and two for adolescents or adults. An effort should be made to include tests discussed in class as well as some tests students have not been exposed to.

3. Students should take some notes from the reviews they read, including information on the name and author of each test, the aspects of intelligence measured by each test, the age ranges for which each test is appropriate, information on the reliability and validity of the tests, and the populations used to standardize the tests (norm groups). If possible, students should note any information available on how well each test predicts later intelligence and how test bias has been minimized.

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4. Students should then write a five- to seven-page report summarizing information learned about the tests (they might include a table with information about each test). The report might include a rating of each test as good, fair, or poor in overall quality and justifications for ratings based on information obtained and course material on intelligence and intelligence testing. At the end of the report, students should add their raw notes taken at the library about each test.

5. Instructors should encourage students to discuss their experiences with the class, focusing on what they learned about intelligence tests not covered in the course and how such tests compare with those covered in class. Discussion might center on the limitations of the psychometric approach to observing intelligence, and students might see why other theories of intelligence might be very important in the discussion of intelligence generally.

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