Impulsive and Self-Conscious: Adolescents' Vulnerability to Advertising and Promotion

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In this article, the authors review basic research on adolescent development in neuroscience, psychology, and marketing. The findings indicate that adolescents are more impulsive and self-conscious than adults. In addition, the adolescent brain's plasticity makes it more vulnerable to harm. Thus, there is emerging justification for restricting adolescents' exposure to advertising and promotions for high-risk, addictive products, especially if impulsive behaviors or image benefits are depicted.

This article provides a multidisciplinary review of research that is related to an important and timely public policy issue: Is adolescence a period of heightened vulnerability to the influence of advertising and promotions? We conduct this review in response to the growing concern that marketers may be unfairly exploiting adolescents (Kasser and Kanner 2004; Linn 2004; Quart 2004), particularly tobacco and alcohol marketers (King et al. 1998; Pucci and Siegel 1999). The concern about exploitation is based in part on the belief that adolescents may be especially susceptible to marketers' influence attempts (Cohen 2000; Pollay et al. 1996; U.S. Department of Health and Human Services 1995b).We address the issue of adolescent vulnerability by reviewing the basic research on adolescents' cognitive and emotional development that has been conducted in three academic disciplines: neuroscience, psychology, and marketing. We also examine how the U.S. tobacco and alcohol industries try to protect adolescents through self-regulation and the tobacco settlement.

We begin with the assumption that adolescents are susceptible to influence by advertising, including tobacco and alcohol advertising, which we base on several comprehensive reports that reach this conclusion (Hastings and Aitken 1995; Lynch and Bonnie 1994; U.S. Department of Health and Human Services 1995a; Wakefield et al. 2003). We then address a fundamentally different set of questions: Are adolescents more susceptible to advertising and promotions than adults? If so, why and under what circumstances? To address these questions, we review the basic science of adolescent development, but unlike prior reviews (Cauffman and Steinberg 1995; Steinberg and Scott 2003), we focus on marketing and public policy implications.

Our review indicates that adolescents tend to be more impulsive and self-conscious than adults because of the neurobiological changes that occur during this critical developmental period. Thus, adolescents may be especially attracted to risky branded products that, in their view, provide immediate gratification, thrills, and/or social status. Because of the adolescent brain's rapid change or "plasticity," harmful products may pose more of a risk to adolescents than to adults; for example, the likelihood of addiction appears to be higher. The main implication of our review is that policy officials may want to consider comprehensive federal legislation to protect adolescents from advertising and promotions for high-risk, addictive products as much as is feasible given constitutional constraints. Of particular concern are marketing materials that seem to be especially attractive to adolescents, including depictions of risky, impulsive behavior and psychosocial, image benefits. However, we note that several important research questions remain unanswered, and we recommend that further studies be conducted in areas that we identify subsequently.

Boundaries and Risks of Adolescence

Adolescence is commonly defined as the interval between the onset of puberty and the transition to adult roles (Steinberg et al., in press). The temporal borders of this developmental period are not precise. At the lower boundary, the onset of puberty involves a series of overlapping physiological changes, including a rise in hormones, the onset of menstruation for females, and the maturation of the ovaries or gonads. These changes may begin as early as ages 6 to 8 and may not end until ages 15 to 17 (McClintock and Herdt 1996). However, on average, menstruation begins at approximately 12–13 years of age in industrialized nations and later in nations plagued with malnutrition and disease (Eveleth and Tanner 1990; Herman-Giddens et al. 1997). The age at which youths reach the upper boundary of adolescence and take on adults roles, such as self-supporter, spouse, and parent, also varies considerably across people and cultures.

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In this article, we adopt the conventional view that adolescence is roughly synonymous with teenager, or ages 13–19. Note, however, that studies indicate that the period of adolescence has lengthened in the United States. In particular, many scholars argue that adolescence begins at approximately age 10 and does not end until the early 20s (Steinberg 2002). Research shows that boys and girls report feeling sexually attracted to others at around age 10, an age that corresponds to maturation of the adrenal glands in many children (McClintock and Herdt 1996). Furthermore, youths often pursue graduate degrees and delay careers, marriage, and parenthood, remaining economically dependent on their parents well after they reach the age of 20.

Most youths manage the transition to adulthood successfully, but adolescence is undoubtedly a period of heightened susceptibility to many disorders. Many behavioral and emotional problems, such as substance abuse and eating disorders, are rarely observed before adolescence. Others, such as major depression or bipolar illness, increase in prevalence in adolescence (Steinberg et al., in press). A recent review (Dahl 2004) reports that morbidity and mortality rates double between the early school years and late adolescence. Major causes of death and disability are related primarily to adolescents' difficulties in controlling either their emotions (e.g., violence, depression, suicide, homicide) or their impulses (e.g., eating disorders, substance abuse, health problems related to risky sexual behaviors, reckless driving) (Blanken 1993; Fingerhut and Warner 1997; Snyder and Sickmund 1999).

Neurobiological Bases for Adolescent Vulnerabilities

New noninvasive brain imaging techniques, especially functional magnetic resonance imaging (fMRI), permit investigators to characterize the structure and activity patterns of the adolescent brain. Complementary animal studies have begun to examine the unique physiological, morphological, and neurochemical properties of the adolescent brain. These studies reveal adolescence to be a period of rapid brain development and maturation. The adolescent brain's plasticity may cause vulnerabilities because structures and systems that are undergoing massive change are highly susceptible to negative environmental input.

Brain Structures and Systems

To comprehend the advances in neuroscience that have begun to clarify the functional characteristics of the adolescent brain, it is necessary to understand the basic brain systems that underlie motivated behavior. A complex circuit of linked brain structures plays a crucial role in the integration of environmental information with internal drives and memories to produce motivated behavior. This circuit is known as the limbic system (see Figure 1).

Circuits at both cortical and subcortical levels process sensory information about the environment. A key subcortical structure is the amygdala, which serves a vital role in social cognition by transforming experiences into feeling (Adolphs 2001; Haxby, Hoffman, and Gobbini 2002). Sensory information transmitted to the amygdala is rapidly analyzed for its emotional content and then is sent to other brain structures that process movement and memory. If incoming sensory information is aversive, the amygdala will respond with fear and will activate behavioral responses through striatum and brain stem outputs (Davis and Whalen 2001). This rapid subcortical processing of sensory input permits an automatic behavioral response to threats that may affect survival. The amygdala plays a similar role in appetitive drives, such as sexual behavior (Everitt et al. 2003). The amygdala, which is phylogenetically one of the older subcortical brain regions, is also a principal target for stress and gonadal hormones (Newman 1999; Sapolsky 2003). These hormones serve important roles in regulating amygdala response to the environment, and they contribute to sex differences in social behavior (Hamann et al. 2004; Newman 1999).

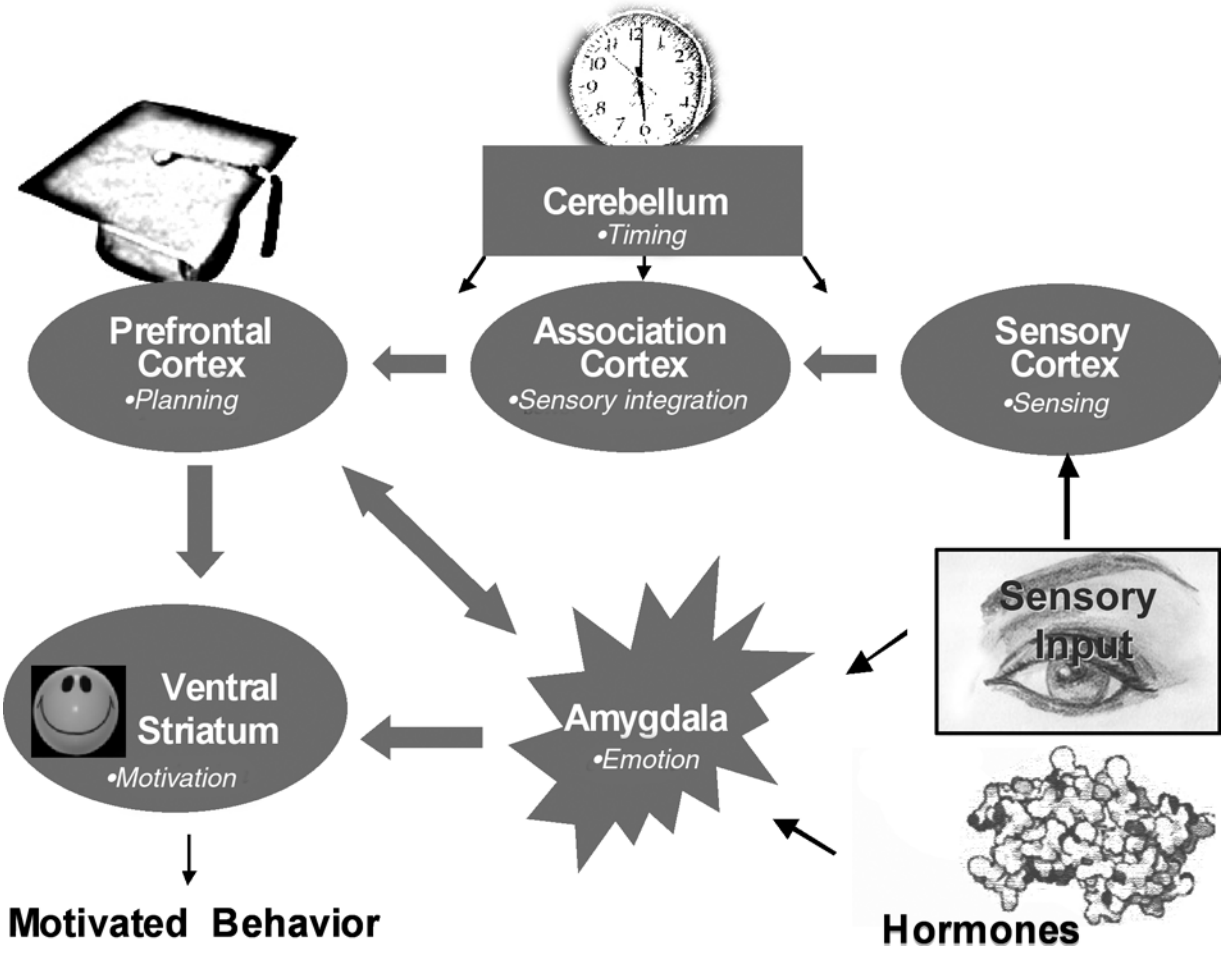
Incoming sensory information is also relayed to the sensory cortex, where it is processed and transferred to an association cortex for integration with other sensory modalities. This integrated sensory experience is then relayed to the prefrontal cortex, which serves an executive, decision-making role in that it uses prior experiences to guide behavioral responses (Arnsten 1997). Activation of the prefrontal cortex inhibits inappropriate responses and environmental distractions and permits planning and execution of organized behavior. In adults, activation of the prefrontal system can inhibit amygdala activity (Grace and Rosenkranz 2002); thus, planned behavior resulting from prior experience can override impulsive responses to the environment.

Neuronal activity in these limbic circuits can be modulated by monoamine neurotransmitter pathways that originate in the hindbrain, including norepinephrine, serotonin, and dopamine (Joyce, Goldsmith, and Gurevich 1997). In particular, dopamine serves a critical role in defining the salience of an environmental stimulus and in regulating motivated behavior (Grace and Rosenkranz 2002; Kelley 2004; Wise 2004). Dopamine is released in the ventral striatum in response to novel stimuli and natural rewards, and it acts as a "go" signal to activate exploratory behavior. Dopamine release in the prefrontal cortex and the amygdala also regulates emotional learning by "stamping in" stimulus–reward and response–reward associations.

Changes in Brain Structure and Function

The brain does not grow in overall size after about the age of six, but substantial structural and functional reorganization occurs throughout adolescence (Giedd 2004; Gogtay et al. 2004; Koshibu, Levitt, and Ahrens 2004; Sowell et al. 2001). Most of this structural change appears to progress independent of puberty and is a function of age and experience. The outer cortical layers of the brain are made up of densely packed neurons interspersed with glial support cells, and there are complex connections between them. Synapses, or points of contacts between neurons, are also abundant; there are tens of thousands of such contacts per millimeter. The underlying layers contain long projections between cortical regions and outgoing connections to subcortical neuronal groups. These pathways are insulated by myelin-forming support cells to speed electrical conduction. Myelinated projections appear white in fresh brain sections because of their high fat content and are called white matter.

Figure 1. Simplified Schematic of the Neural Circuitry Underlying Motivated Behavior



Notes: The amygdala processes environmental sensory cues for emotional content and stimulates automatic and impulsive behavioral responses. The prefrontal cortex receives highly processed sensory information and mediates planning of appropriate behavioral outcomes. The prefrontal cortex can inhibit impulsive behavior driven by the amygdala, but it matures late in adolescence.

Cell dense neuronal tissue appears gray and is called gray matter.

The increasing cognitive capacity of the adolescent brain coincides with a decrease in cortical gray matter thickness, which is believed to result from a loss of synapses between neurons and a concomitant strengthening of remaining synapses. This process, which has been well documented in both humans and animals (Huttenlocher 1979; Klintsova and Greenough 1999; Moody 1998), is known as experience-dependent plasticity. Adolescence is a period of massive, experience-dependent pruning of unnecessary synapses; gray matter density in the whole brain peaks at the age of 11.5 in girls and 14 in boys and declines thereafter (Durston et al. 2001; Giedd 2004). At the same time, the brain exhibits an increase in white matter content, which is believed to reflect increased nerve insulation, or myelination, and a resulting increase in the efficiency of impulse conduction rates.

The developmental changes that are observed in gray and white matter content are not homogeneous; they show regional differences throughout the brain, indicating different rates of maturation for different structures. Time-lapse sequences show that cortical regions associated with more basic functions, the primary motor and sensory cortices, mature earliest, and there is little further change in gray matter density during adolescence (Giedd 2004; Gogtay et al. 2004). Cortical areas involved in spatial orientation, speech, and language are next to mature. Higher-order cortices involved in executive control, attention, and motor coordination are last to mature and are actively restructured during adolescence, as is the temporal association cortex that integrates memory, audiovisual association, and object-recognition functions.

Both human and animal studies have shown that some other brain regions and neuronal projections also mature relatively late. There is a striking increase in the volume of the amygdala throughout adolescence, particularly in males

(Durston et al. 2001; Koshibu, Levitt, and Ahrens 2004). Neuronal interconnections between the amygdala and the prefrontal cortex, which enable cognitive control of emotional processes, are also relatively immature at the beginning of adolescence and do not complete their development until adulthood (Cunningham, Bhattacharyya, and Benes 2002; Killgore, Oki, and Yurgelun-Todd 2001). The hippocampus, which encodes context and is critically involved in memory formation, continues to increase in size throughout adolescence, particularly in females (Durston et al. 2001; Koshibu, Levitt, and Ahrens 2004). The cerebellum, which regulates the timing of motor and cognitive sequences, continues maturating into young adulthood (Diamond 2000).

As a result, young adolescents in particular demonstrate several weaknesses in cognitive processing compared with adults. Such weaknesses include poorer frontal lobe executive function (Adleman et al. 2002), worse visuospatial and delayed verbal memory (Sowell et al. 2001), and slower reaction time (Spear 2000). The cognitive control of reflexive eye movements, which depends on executive function and is related to behavioral inhibition, does not mature until adulthood (Luna et al. 2001). Adolescents also show poorer computational efficacy of the prefrontal cortex than adults, perhaps in part because they are less able to activate brain regions, such as the cerebellum, that underlie processes related to timing and sequencing (Luna and Sweeney 2004).

Experience-Dependent Plasticity

The massive structural changes in the brain and associated experience-dependent plasticity that occur during adolescence cause this to be a critical period in limbic system development that is highly sensitive to environmental input. A recent study demonstrated this plasticity by comparing adolescents who were learning to solve algebraic equations with adults who were experienced in algebra (Qin et al. 2004). The same brain regions were activated for both adolescents and adults, but practice decreased neural responding in the parietal cortex and increased it in the striatum only among adolescents.

Adolescents' enhanced plasticity in response to new challenges affords learning advantages but may underlie their greater vulnerability to environmental toxins and stresses. The rapid rate of change within limbic structures, such as the cortex, hippocampus, and amygdala, also makes adolescents particularly vulnerable to long-term damage (Andersen 2003). Stress-related psychopathologies often emerge during the adolescent maturation of the limbic system (Walker, Sabuwalla, and Huot 2004). Although transient adjustment problems are common, in some teenagers, such problems can portend a lifetime of mental disorders. Furthermore, certain consumption behaviors pose a greater risk when initiated in adolescence as opposed to adulthood, as we discuss subsequently.

Hormonal Changes

Adolescence is also associated with substantial changes in the circulating levels of steroid hormones. Adrenarche, or adrenal puberty, occurs at or before the age of ten and results in an elevated release of adrenal androgens in both males and females. The adrenal androgens have substantial activational effects on both brain and periphery and are implicated in the development of pubic hair, acne, and the onset of sexual attraction in both sexes (Auchus and Rainey 2004; Herdt and McClintock 2000). Release of the adrenal stress glucocorticoid hormones does not rise dramatically in parallel with that of adrenal androgens. However, glucocorticoid secretion and regulatory control do show significant changes in adolescence, indicating that stress responses to environmental stimuli are maturing (Gomez, Houshyar, and Dallman 2002; Romeo et al. 2004; Viau et al. 2005). Evidence suggests that adolescents are hypersensitive to the effects of stress and that stress hormones may produce long-term changes in brain structure and function (Walker, Sabuwalla, and Huot 2004).

Menarche, or gonadal puberty, is associated with elevated circulating levels of sex steroids, which produce the peripheral manifestations of pubertal growth and development. The onset of gonadal puberty in the developed world is occurring much earlier today than in previous generations (Herman-Giddens et al. 1997), though there is no evidence that the timing of adrenarche is labile. Gonadal steroids also have pronounced effects on brain function. Emotional response and social dominance behavior are associated with the pubertal surge of gonadal steroids (Buchanan, Eccles, and Becker 1992; Rowe et al. 2004). Gonadal steroid actions during adolescence also play critical roles in the maturation of brain circuitry underlying adult sexual behavior (Sisk and Foster 2004).

Neuronal Activation and Cortical Function

Among adolescents, the increased gonadal hormone actions on the amygdala and other subcortical regions enhance excitatory drive for social behaviors and exploration. Yet the cortical inhibitory control systems that are responsible for planning and organized behavior are immature. The mismatch in excitatory drive and inhibitory control during early adolescence has been likened to "starting the engine with an unskilled driver" (Dahl 2004, p. 17). In animals as well, the prefrontal cortex and associated inhibitory control are not fully mature until adulthood (Benes, Taylor, and Cunningham 2000; Lambe, Krimer, and Goldman-Rakic 2000; Lewis 1997). Thus, immature executive control is believed to underlie the greater risk-taking behavior and novelty seeking that is a hallmark of adolescence across all species (Spear 2000).

Because of ethical limitations in human research, much understanding of the underlying mediational processes comes from research on rodents and nonhuman primates (Spear 2000). This research has established that in adults, dopamine and norepinephrine projections to the prefrontal cortex mediate important regulatory control over excitatory output cells (pyramidal cells) and intrinsic inhibitory cells (interneurons) (Arnsten 1997; Goldman-Rakic, Muly, and Williams 2000). Whereas moderate activation of these transmitter inputs optimizes prefrontal cortex function and executive planning, overactivation by stress "shuts down" prefrontal function and permits reflexive, habitual, and impulsive responses to control behavior. Dopaminergic inputs to prefrontal pyramidal cells continue to mature

throughout adolescence into adulthood (Benes, Taylor, and Cunningham 2000; Lambe, Krimer, and Goldman-Rakic 2000; Tseng and O'Donnell 2005).

In the nonhuman primate and rodent, an "overshoot" of dopamine input to some parts of the prefrontal cortex has been observed during puberty, with a subsequent decline to adult levels (Lewis 1997). Furthermore, neurochemical studies reveal concurrent changes in the receptor proteins that mediate dopamine's actions. Dopamine receptor levels in the rodent prefrontal cortex and striatum peak just after puberty and then decline to substantially lower adult levels (Andersen et al. 2000; Tarazi and Baldessarini 2000). Thus, for a given level of neuronal activation, there will be greater dopamine release and receptor stimulation in adolescents than in adults.

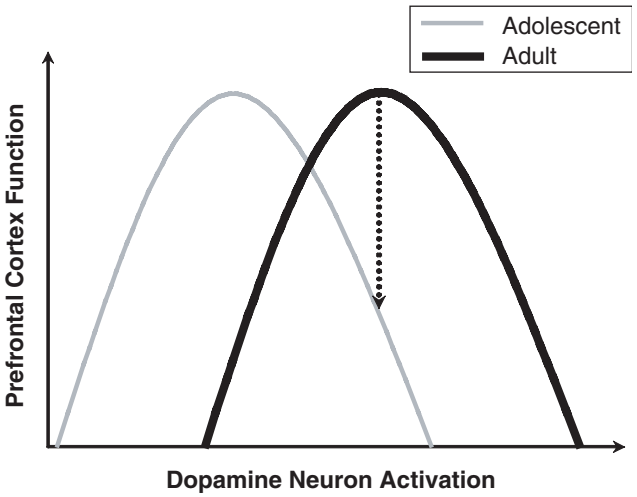
Dopamine signaling in the prefrontal cortex and its striatal outputs in response to novel stimuli play a critical role in experience-dependent neuronal plasticity and instrumental learning (Kelley 2004; Waelti, Dickinson, and Schultz 2001; Wise 2004). Thus, hyperreactivity of dopaminergic response during adolescence is undoubtedly critical to the maturational processes that occur in prefrontal systems. Because there is an inverted U-shaped relationship between dopamine signaling and prefrontal cortex function, however, it could be predicted that the hyperresponsiveness of dopaminergic systems impairs cognitive function in adolescents under milder stress conditions than adults. This is consistent with behavioral observations that adolescents perform many cognitive tasks as well as or better than adults under low-stress or "cold cognition" conditions (Ernst et al. 2003; Leslie et al. 2004), but they exhibit markedly disrupted performance under conditions of even mild stress or "hot cognition" (Gardner and Steinberg, in press).

Figure 2 illustrates this inverted U-shaped relationship between dopamine neuronal activation and prefrontal cortex function. The adolescent (versus adult) function is shifted to the left, showing adolescents' greater sensitivity to stimulus activation. The dotted arrow represents response to a mild stress-induced stimulus. This stimulus produces optimal cortical function among adults (peak of black line) but suboptimal function among adolescents (to the right of the peak of the gray line).

Summary

Neuroscience research indicates that the prefrontal cortex, which is critical for inhibitory control, is not fully developed until late adolescence or early adulthood. Furthermore, hormonal levels and hormonal receptivity are elevated during adolescence, and thus lower levels of stress or emotion can cause inhibitory systems to go "offline" more readily. Thus, it appears that a temporal gap exists between the onset of puberty and its powerful urges and emotions and the later, more gradual development of regulatory mechanisms (Steinberg et al., in press). Next, we discuss several implications for adolescent behavior and decision making.

Figure 2. Hypothesized Age Differences in the Relationship Between Dopamine Neuronal Activation and Prefrontal Cortex Function



Notes: In both adolescents (gray line) and adults (black line), there is an inverted U-shaped relationship between dopamine activation and prefrontal cortex function: Mild activation produces enhancement of cortical function, whereas strong activation produces inhibition. Thus, a relatively mild stress-induced stimulation (dotted arrow), which yields optimal cognitive function for an adult (peak of black line), yields impaired cognitive function for an adolescent (to right of peak of gray line).

Adolescent Impulsivity and Risk Seeking

Sensation Seeking

Adolescents' strong pubescent urges lead to sensation seeking, which is defined as the need for and pursuit of varied, novel, and complex experiences (Zuckerman 1979). Martin and colleagues (2002) assess sensation seeking in adolescents between the ages of 11 and 13. They find no significant correlation between sensation seeking and age, but they find a significant correlation between sensation seeking and pubertal stage among both sexes. Adolescent pubertal development also leads to more intense sexual impulses (McClintock and Herdt 1996; Neemann, Hubbard, and Masten 1995). As transient traits, attraction to novelty combined with strong sexual feelings may be adaptive by promoting behaviors that are essential to the transition from adolescence to adulthood, in particular, venturing outside the family unit and reproducing with nonfamily members (Spear 2000). Unfortunately, risky and maladaptive behaviors may also increase.

Inhibitory Control

Whereas adolescents experience more intense urges, the skills required to control these urges are in short supply; such skills do not develop with the onset of puberty but rather improve gradually with age and experience (Cauffman and Steinberg 2000; Dahl 2004). Inhibitory or impulse control—also referred to as the cognitive regulation of emo-

tions, executive control, or, more colloquially, self-control—refers to the ability to inhibit, delay, or modify an emotion or impulse or its behavioral expression to avoid negative outcomes and attain long-term goals (Thompson 1994). The skills that are necessary for this include planning, monitoring, evaluating, and reflecting. They are evidenced when a person focuses attention on a problem and blocks out irrelevant thoughts or when a person forgoes an immediate reward in favor of a more valuable outcome to be achieved subsequently. Such emerging abilities have been linked to the maturation of the prefrontal cortex, a brain region involved in long-term planning and deliberate decision making that does not fully develop until late adolescence or early adulthood. Compared with adults, adolescents report less use of cognitive strategies, such as distraction and positive reappraisal, to regulate emotions (Folkman et al. 1987; Gross et al. 1997).

Impulsive and Risky Behavior

Because adolescents experience strong pubescent urges and have weak inhibitory control, they are more likely than either children or adults to pursue reckless and risky activities (Cauffman and Steinberg 2000; Greenberger 1982; Spear 2000; Steinberg and Cauffman 1996; Wulfert et al. 2002). In a survey of adolescents between the ages of 11 and 15 (Maggs, Almeida, and Galambos 1995), 80% reported engaging in one or more problem behaviors during the previous month, such as disobeying parents, school misconduct, substance use, driving while intoxicated, unprotected sex, theft, or fighting. It has been argued that reckless behavior is so prevalent during adolescence that it is the norm rather than the exception (Moffitt 1993; Trimpop, Kerr, and Kirkcaldy 1999). However, some adolescents are more impulsive than others, which affects their likelihood to engage in substance abuse. Chambers, Taylor, and Potenza (2003) find that adolescents who made impulsive choices (preferring a lesser, immediate compensation rather than a greater, delayed compensation for study participations) reported a greater use of cigarettes, alcohol, and marijuana. Similarly, longitudinal studies have found that high levels of impulsivity predict adolescent substance use (Colder and Stice 1998).

Research also indicates that adolescents' psychological immaturity, or weak inhibitory control, is a significant predictor of their risky decisions and actions. Cauffman and Steinberg (2000) administered questionnaires to more than 1000 8th, 10th, and 12th graders and to college students (ages 12–48). The questionnaires assessed psychological maturity, such as participants' tendency to limit impulsivity, consider the long-term consequences of their actions, and forgo immediate gratification. Participants also responded to hypothetical scenarios about antisocial and risky behaviors. The results indicated that psychosocial maturity improved as a function of age through approximately age 19. Responsible decision making (as assessed by hypothetical scenarios) was significantly less common in adolescents than in young adults. Psychosocial maturity was a key predictor of responsible decision making.

Emotional Turmoil

Furthermore, adolescents tend to experience more frequent and intense negative emotions, diminished positive emotions, and greater emotional volatility than both younger and older people. Several longitudinal studies have shown that negative affect increases from preadolescence to adolescence (Buchanan, Eccles, and Becker 1992). Larson and Richards (1994) collected data from 55 Chicago family members, including mother–father–adolescent triads, and from 483 additional children in Grades 5–9. Participants completed reports of their activities and emotions when paged at random moments during the day. Across the thousands of times they recorded their feelings, adolescents reported more intense and frequent negative emotions. They also experienced positive situations as less pleasurable than older or younger people. Indeed, between late childhood and early adolescence, the number of reports of feeling "very happy" dropped by 50%. Even in response to seemingly identical events, adolescents experienced more negative emotion and less positive emotion than younger children or adults. In a related study (Larson et al. 2002), 220 youths provided reports on their daily emotions in Grades 5–8 and again four years later when they were in Grades 9–12. The youths' average emotional state became increasingly negative with age until about Grade 10 (approximately age 16). A different study indicates that youths' negative affect may remain elevated through age 18 (Holsen, Kraft, and Vitterso 2000).

Other studies have likewise found negative moods to be common in adolescence. Whalen and colleagues (2001) used surveys and electronic diaries to examine heath behaviors, mental health symptoms, and moods. Adolescents with mental health symptoms (depression, delinquency, and aggression) reported feeling sad on 16%–40% of occasions, angry on 26%–55% of occasions, and anxious on 35%–60% of occasions. A review of research on depression in adolescents concluded that they have higher rates of depressed mood than either children or adults (Petersen et al. 1993). A total of 14 studies on adolescents were reviewed, all involving nonclinical samples, and more than one-third of adolescents met the criteria for clinical depression. The findings of an fMRI study of face recognition are consistent with the notion that adolescents experience more negative emotions than adults (Nelson et al. 2003). Whereas adolescents exhibited greater cortical brain activation in response to angry or fearful faces, adults showed greater cortical activation for happy and neutral faces.

In his review of this literature, Arnett (1999) concludes that though not all adolescents experience "storm and stress," emotional turmoil is more likely during this period than others. No single explanation accounts for the changes in emotional experience that occur in early adolescence or for the return of relative emotional stability in late adolescence or early adulthood. "Raging hormones" are a popularly cited cause. Research confirms that the hormonal changes that accompany puberty indeed contribute to negative moods and emotional volatility in early adolescence (Arnett 1999; Brooks-Gunn, Graber, and Paikoff 1994). However, this hormonal contribution seems to be relatively

small and is accentuated by contextual factors, such as stressful life events.

Compared with younger and older people, adolescents tend to experience a larger number of stressful transitions and negative life events. Early adolescence is accompanied by bodily changes, transition to schools that are often larger and more demanding, changes in peer expectations, and changes in relationships and roles within the family (Larson et al. 2002). In contrast to younger children, adolescents often face these challenges with less reliance on the adults who provided structure and guidance during childhood (Steinberg et al., in press). People's interpretations of challenging events also play an important role in determining their emotional reactions. Larsen and Ham (1993) propose that advances in the ability to think abstractly may increase adolescents' cognitive awareness of the implications of events and actually make adolescents more vulnerable to negative events. Affect may stabilize in late adolescence as a result of both an increased ability to regulate emotions and less change in adolescents' daily experiences.

Inhibitory Control Given Emotional Turmoil

Negative emotions (e.g., feelings of anger, depression, anxiety) may further disrupt adolescents' already tenuous control over their impulses and urges. Research shows that regulating emotional distress often takes precedence over impulse control. People who experience emotional distress value short-term pleasures that may relieve their distress. In a series of studies, Tice, Bratslavsky, and Baumeister (2001) induced negative affect in undergraduates, which increased their tendency to eat fattening snacks, pursue immediate gratification, and engage in frivolous procrastination. This tendency to indulge immediate impulses was eliminated when participants were informed that the mood-induction procedure would elicit a negative mood that was unchangeable for a certain period of time.

Shiv and Fedorikhin (1999, 2002) manipulated the context in which undergraduates were asked to choose between an impulse product (chocolate cake) that was associated with positive affect but unfavorable cognitions and a nonimpulse product (fruit salad) that was associated with less positive affect but more favorable cognitions. When participants were asked to choose quickly and were preoccupied, they were more likely to select the positive affect, impulse product. This pattern was particularly pronounced for those who scored high on impulsivity. The implication is that when adolescents' processing resources are constrained because of factors such as high negative affect, they may be especially prone to acting on their impulses. Consistent with this view, Whalen and colleagues (2001) find that teenagers who reported high levels of negative emotions also reported elevated urges to engage in risky health behaviors. Tercyak and colleagues' (2002) findings indicate that adolescents with negative affect disorders may be more persuaded by cigarette advertisements. In this study, adolescents with clinical symptoms of depression and evidence of cigarette ad receptivity (e.g., a favorite cigarette advertisement) were more likely to have smoked at least once (71%) than nondepressed youths with evidence of cigarette ad receptivity (50%).

Yet another study (Gardner and Steinberg, in press) investigated adolescent decision making in conditions of high arousal or hot cognition as opposed to low arousal or cold cognition (Metcalfe and Mischel 1999; Steinberg et al., in press). Adolescents (ages 13–16), older youths (ages 18–22), and adults (ages 24+) completed questionnaires that assessed risk preferences and risky decision making and a behavioral driving simulation task that assessed risk taking. Participants completed the measures either alone (low arousal) or in a group with two same-aged peers (high arousal). The results showed that risky decisions and behaviors decreased with age. Furthermore, participants in a high-arousal (versus low-arousal) state focused more on the benefits of risky decisions and took more risks. Finally, adolescents and older youths were more strongly affected by high arousal than adults. In conclusion, considerable evidence suggests that adolescents' heightened negative arousal contributes to their tendency to engage in risky, impulsive acts.

Cognitive Risk Assessment

Researchers have also examined potential limitations in adolescents' cognitive risk assessment in laboratory settings that are characterized by low emotion, low arousal, or cold cognition. Specifically, researchers have asked the following question: Are adolescents less knowledgeable and/or less concerned than adults about the potential consequences of risky behavior? The answer is unclear; the findings have been mixed. Several studies have shown that compared with adults, adolescents exhibit greater optimistic bias or the tendency to view the risks of various behaviors as lower for the self than for others (Weinstein 1980). For example, Levine and colleagues (2005) find that adolescents in Southern California viewed the attacks of September 11 as having greater impact on peers than on themselves; their parents did not. Another study finds that adolescents expected to experience less harm as a result of engaging in risky activities than did their parents (Cohn et al. 1995). In a survey about smoking, significantly more adolescents than adults stated that they could smoke for a few years and then quit before experiencing serious health consequences because they would not become addicted (Arnett 2000).

Furthermore, researchers have used gambling tasks to compare the relative weights that adolescents and adults attach to risks versus rewards. The results indicate that compared with adults, adolescents' choices tend to be driven more by rewards and less by risks (Furby and Beyth-Marom 1992; for a review, see Steinberg and Scott 2003). In another study (Moore and Gullone 1996), adolescents were asked to generate a list of common risky behaviors and rate them in terms of the perceived pleasantness of positive outcomes, the perceived unpleasantness of negative outcomes, and the likelihood of both types of outcomes. Adolescent risk taking was shown to be strongly influenced by the perceived pleasantness of positive outcomes. Parsons, Siegel, and Cousins (1997) find that both risks and benefits influenced adolescents' intent to engage in risky behavior, but benefits were a better predictor of actual risky behavior.

In contrast to these findings, however, other studies comparing decision making in adolescents and adults reveal more commonalities than differences. The general consen-

sus is that the major gains in the capacity to think abstractly and make reasoned decisions in low-arousal settings occur between childhood and adolescence rather than between adolescence and adulthood (Keating 1990; Steinberg and Cauffman 1996). In laboratory studies in which adolescents are asked to think through hypothetical scenarios and reach decisions, adolescents have been found to make decisions using the same basic processes as adults (Beyth-Marom et al. 1993). This similarity holds even for complicated decisions, such as whether to abort a pregnancy (Lewis 1987). Moreover, instead of displaying ignorance about risks, adolescents rate the likelihood of some negative outcomes (e.g., accidental pregnancy, drunk driving accident) as greater than do adults and as greater than is indicated by the statistics for their age groups (Fischhoff et al. 2000; Millstein and Halpern-Felsher 2002a, b; Quadrel, Fischhoff, and Davis 1993).

Thus, the research findings are somewhat inconclusive about whether adolescents display weaknesses in cognitive risk assessment compared with adults. Some studies suggest that adolescents focus more on gains and less on losses than adults. Other studies indicate that adolescents are both knowledgeable and concerned about risks and sometimes even overestimate risks. However, these studies have been conducted in cold cognition or low-arousal settings. Adolescents tend to make riskier, more impulsive decisions than adults in hot cognition settings because of their relative inability to regulate strong emotions and urges, as we discussed previously.

Summary

With the onset of puberty, adolescents experience more intense urges. Yet the ability to resist acting on urges is not fully developed until late adolescence or early adulthood. Furthermore, adolescents often experience strong negative emotions that may overwhelm their already weak inhibitory control. When they experience strong negative moods, they may indulge immediate impulses and use risky, addictive products. We discuss implications for marketing and public policy subsequently.

Adolescent Self-Consciousness and Reliance on Consumption Symbols

Self-Consciousness

Research shows that the capacity to engage in abstract thought develops in early adolescence. In a classic study, researchers directed participants of various ages to reason through a variety of scientific and social problems (Inhelder and Piaget 1958). They found that in contrast to younger children, adolescents and adults manifest the ability to think about multiple variables in systematic ways, to formulate hypotheses, and to understand abstract concepts and relationships. Although this growing ability to think abstractly is an asset, it tends to cause adolescents to experience self-consciousness and social anxiety until they develop relevant coping skills.

Because adolescents develop the capacity to engage in abstract reasoning about their own and other people's thoughts, they may envision social threats to their well-being that they never previously considered (Larson and Richards 1994). For example, they may construct negative images of how they appear to others during social encounters (Clark and McManus 2002; Pine 2001; Spurr and Stopa 2002). As a result, adolescents report feeling self-conscious and embarrassed about two to three times more often than do their parents (Larson and Richards 1994). Rosso and colleagues (2004) explicitly examine the relationship between abstract reasoning and social anxiety among 20 adolescents between the ages of 9 and 18. The adolescents completed a neuropsychological battery and measures of social anxiety. Reported social anxiety increased moderately with age, though not significantly at this sample size, and greater abstract reasoning skill was significantly associated with greater social anxiety.

Peer Influences

Two objective challenges of adolescence, forming a personal identity and fitting in socially with peers, likely contribute to adolescents' heightened self-consciousness. According to Erikson (1968), the primary developmental task of adolescence is the struggle to formulate an identity that is independent of parents, a struggle that typically lasts until late adolescence or early adulthood. In the midst of this struggle, it is understandable that adolescents would be self-absorbed and self-conscious. Furthermore, adolescents often turn to peers to help them forge identities that are independent of their parents, which may make them even more self-conscious.

Research indicates that susceptibility to peer influence peaks in early adolescence and then slowly declines during high school (Steinberg and Scott 2003). For example, when adolescents are presented with hypothetical dilemmas in which they must choose between an antisocial behavior suggested by peers and a prosocial behavior, they are more likely than younger children to follow peers (Steinberg and Silverberg 1986). Adolescents are also more likely than younger children to identify peers as their most important role models (Brown 1990). Finally, in adolescence, the amount of unsupervised time spent with peers increases dramatically, and there is a corresponding decrease in the time spent with parents or other adults (Brown 1990; Larson and Richards 1991). This closer level of social engagement with peers seems to lead to higher levels of self-consciousness, particularly among girls (Rankin et al. 2000). Among adolescents, just being around peers has been found to increase arousal (Gardner and Steinberg, in press).

Consumption Symbols

According to Solomon's (1983, 1992) symbolic interactionism theory, adolescents' self-consciousness and social anxiety should tend to make them more receptive to image advertising and high-status, heavily advertised brands. The theory posits that consumers often buy products not for their functional attributes but rather for their image attributes or value as consumption symbols. That is, products are often bought because they are believed to project positive social roles or images, which in turn leads to higher perceptions of self-worth. A main tenet of the theory is that in periods of transition, a person's uncertainty about his or her ability to

attain a desired role state can cause a greater reliance on consumption symbols. During transition periods, people use consumption symbols to signal to themselves and to others that the desired end state will be attained. Because adolescence is a major transition period associated with considerable self-doubt, it follows that adolescents should be highly attracted to high-status consumption symbols. Adolescents should also be highly attuned to image advertising because it is a primary mechanism by which brands convey their value as consumption symbols. The goal of most image advertising is to suggest that the featured brands help a person look better, feel better, attract sexual interest, and impress friends (Masten 2004).

Research indicates that adolescents show a heightened interest in consumption symbols compared with younger children. However, the findings conflict as to whether interest in brands peaks in early or late adolescence or early adulthood. In one study, high school students reported more brand preferences than middle school students (Moore and Stephens 1975). Another study found age (12–18 years old) to be positively correlated with brand knowledge and ad-based information search (Moschis and Churchill 1979). An investigation of clothing purchase habits of people between the ages of 9 and 19 determined that age was positively associated with peer influence, interest in advertisements, reliance on brand names, and a desire for the latest fashions (May and Koester 1985).

However, some studies suggest that young adults are even more brand conscious than adolescents. Belk, Bahn, and Mayer (1982) find that an understanding of brand images and consumption symbols emerges by age 8 (second grade), increases through adolescence, peaks in college, and declines thereafter. Likewise, music preferences apparently form around age 24 rather than during adolescence (Holbrook and Schindler 1989). Yet in a survey about catalog clothes shopping (Simpson, Douglas, and Schimmel 1998), it was middle school students (ages 12–14) who reported being most concerned about brand name, style, and the latest fashions, not high school students (ages 15–18). Thus, it appears that adolescents have a heightened interest in brands, but the age at which this interest peaks is not yet known and might vary depending on factors such as product type.

Receptivity to Image Advertising

A few studies in the tobacco area suggest that there are age-related differences in receptivity to image advertising. Pollay and colleagues (1996) used econometric models to relate brand-specific advertising expenditures to cigarette brand market shares among both adolescents and adults during the period from 1974 to 1993. They obtained data on advertising expenditures and adult market shares from standard syndicated sources, and they estimated brand market shares among adolescents from health surveys. They found that brand-specific advertising expenditures had three times more influence on brand shares among adolescents than among adults. In addition, from 1989 to 1993, when R.J. Reynolds promoted Camel using the Old Joe cartoon character, Camel's share of the youth market increased from 8% to 13%, whereas its share of the adult market remained stable at 4% (U.S. Centers for Disease Control and Prevention 1994). Many studies in both the United States and abroad have shown that adolescents are more likely than adults to smoke the most heavily advertised cigarette brands (e.g., Pierce et al. 1991).

Other researchers have found that self-images and cigarette smoker images are more closely aligned among adolescents who smoke or intend to smoke than among nonsmokers (Barton et al. 1982; Burton et al. 1989; Chassin et al. 1981). In other words, smokers or likely smokers perceive themselves as fitting the image of a smoker, which suggests that they use cigarettes to project that image. Additional studies indicate that cigarettes serve as an important cue in social perceptions and that cigarette advertising helps make this cue more salient (Pechmann and Knight 2002; Pechmann and Ratneshwar 1994). Specifically, researchers have found that adolescents responded differently to unfamiliar peers on the basis of whether the peers were shown smoking or not smoking and whether the adolescents viewed smoking-related (versus control) advertisements. Cigarette advertisements enhanced adolescents' perceptions of smokers and also increased their intent to smoke; antismoking advertisements had the opposite effects. Kelly, Slater, and Karan (2002) removed the lifestyle images from beer, cigarette, and soft drink advertisements and found that this lowered adolescents' ratings of the advertisements, brands, and products.

Self-Consciousness and Consumption Symbols

Additional studies link adolescents' self-consciousness and self-doubt to image advertising receptivity. Martin and Kennedy (1993) examined female students' responses to glamorous female models in image advertisements. They found that 8th and 12th graders were more likely to compare themselves with the models than 4th graders. Those with low self-esteem were more likely to draw such comparisons. Among 8th and particularly 12th graders, exposure to the glamorous models also raised the bar or comparison standard for what it means to be attractive. In this study, exposure to the glamorous models did not affect self-rated physical attractiveness, but that effect has been shown previously (Martin and Gentry 1997; Richins 1991). Another study found that adolescent females with poor body images expressed greater liking of attractive advertising models and the products they promoted (Martin, Gentry, and Hill 1999). Survey research suggests that adolescents with low (versus high) self-esteem are more trusting of advertising in general (Boush, Friestad, and Rose 1994). In addition, young adults reared in disrupted families tend to be more materialistic and to engage in more compulsive buying (Rindfleisch, Burroughs, and Denton 1997).

Summary

Adolescence is a period of heightened self-consciousness and self-doubt. Brand consciousness also seems to increase in adolescence, consistent with the notion that adolescents rely on brands to project a positive image to others and to bolster feelings of self-worth. It appears that adolescents with low self-esteem are especially attracted to image adver-

tisements and status brands and that they manifest other signs of materialism.

Adolescents' Elevated Risks from Product Use

Elevated Risk of Addiction

It has been argued that habits and addictions are more readily formed in adolescence than in adulthood (McNeal 1992; Quart 2004; Zollo 2004). For most product categories, no research has been published on age of first use or age at which loyalties are formed. However, research has been conducted on two products: tobacco and alcohol. The findings suggest that adolescents are particularly prone to initiating use and becoming addicted to both products (Kandel and Logan 1984). Addiction is fundamentally different and more problematic than loyalty because it involves biological changes in brain response to mind-altering substances (DiFranza et al. 2002). Social factors have been commonly implicated in teen smoking and drinking, but animal studies now suggest that there is an enhanced biological sensitivity to the rewarding effects of tobacco and alcohol during adolescence (Leslie et al. 2004; Philpot, Badanich, and Kirstein 2003).

In the United States, approximately 80% of adolescents try alcohol by the 12th grade (by approximately age 18; Johnston, O'Malley, and Bachman 2003); the average age of first use is 14 years old (Foster et al. 2003). In addition, 90% of daily smokers try their first cigarette by age 18, and 56% try it by age 13 (Lynch and Bonnie 1994). Smoking and drinking during early adolescence are associated with greater difficulty in quitting and heavier use in later life (Breslau and Peterson 1996; Guo et al. 2000; Taioli and Wynder 1991). One study found that 67% of those who initiated smoking in 6th grade smoked regularly as adults compared with 46% of those who initiated smoking in 11th grade (Chassin et al. 1990). Another study reported that youths who begin drinking before age 15 have a 41% chance of becoming dependent compared with 10% of those who begin drinking after age 19 (Grant and Dawson 1997). It is not entirely clear whether early drug use causes addiction or whether early users are more prone to become addicted for other reasons, such as genetics. However, Grant and Dawson (1997, p. 103) control for many potential confounders and find that "the odds of [alcohol] dependence decreased by 14% with each increasing year of age at onset of use, and the odds of abuse decreased by 8%."

Elevated Risk of Adverse Health and Social Effects

Research indicates that alcohol and tobacco are riskier when used by adolescents than when used by adults. Specifically, there is mounting evidence that because of the plasticity of the developing adolescent brain, it may be especially sensitive to the toxic effects of both products (Crews et al. 2000; Slotkin 2002). In animal studies, administration of nicotine and alcohol during adolescence has been shown to damage the hippocampus, which is involved in memory formation (Jang et al. 2002; Slotkin 2002). Such structural changes may underlie the memory performance deficits that have been reported in adolescent smokers (Jacobsen et al. 2005) and adolescent problem drinkers (Brown et al. 2000; Tapert et al. 2001). Animal studies suggest that nicotine and alcohol exposure during adolescence leads to increased anxiety-like behaviors in adulthood (Slawecki et al. 2003; Slawecki, Thorsell, and Ehlers 2004). Correspondingly, in humans, a prospective study found that smoking during adolescence increased the likelihood of panic disorders in later life (Isensee et al. 2003).

Furthermore, several epidemiological studies have examined the relative risks of alcohol use. The findings indicate that adolescents are more likely to engage in binge drinking than adults and that binge drinking is associated with numerous problems. One U.S. survey found that among drinkers between the ages of 15 and 20 years, 70% drank heavily (5+ concurrent drinks in the past 30 days); among those over 26 years, 39% drank heavily (Bonnie and O'Connell 2004, p. 39). Even when blood alcohol content is controlled for, it appears that alcohol-impaired adolescent drivers are more likely to get into car crashes than adults (Hingson and Kenkel 2004). Heavy drinking among young college students (ages 18–19 years) has been found to impede academic performance (Wechsler et al. 1998), though one study indicates that other factors may play an even more important role, such as comorbid illicit drug use (Wood et al. 1997). Cook and Moore (1993) report that even after controlling for confounding variables, such as aptitude, high school seniors who engaged in frequent and/or heavy drinking completed 2.2 fewer years of college.

It also appears that moderate, though not heavy, drinking increases the likelihood of both sexual intercourse and intercourse without contraception among adolescents (Sen 2002). Alcohol use among adolescents has been linked to violence, crime, suicide, and emotional disorders, and early initiation seems to increase the risks. Hingson and Kenkel (2004) find that even after controlling for factors such as illicit drug use, youths who started drinking before age 15 compared with age 21 or later "were 12 times more likely to be unintentionally injured while under the influence of alcohol, 7 times more likely to be in a motor vehicle crash after drinking, and 10 times more likely to have been in a physical fight after drinking" (qtd. in Bonnie and O'Connell 2004, p. 59).

Summary

The evidence indicates that it is riskier for adolescents than adults to use tobacco and alcohol, two products of particular concern to policy officials. Research suggests that adolescents who use and abuse these products face elevated risks for both immediate, acute problems (e.g., memory deficits, car crashes) and longer-term, chronic problems (e.g., addiction, panic disorders). Furthermore, it appears that the developing brain's plasticity or malleability makes it especially sensitive to these products' toxic effects and perhaps their addictive effects as well.

Conclusions and Regulatory Implications

Adolescent Vulnerabilities

Our review of the neuroscience, psychology, and marketing literature has demonstrated three adolescent vulnerabilities: (1) impulsivity, (2) self-consciousness and self-doubt, and (3) an elevated risk from product use for both alcohol and tobacco. Impulsivity has been linked to the temporal gap between the onset of pubescent urges and the more gradual development of cortical inhibitory control. Self-consciousness is attributable in part to the emergence of abstract thinking. Elevated risk from product use results partially from impulsive behavior (e.g., drunk driving). In addition, the developing brain's plasticity makes it more susceptible to harm from toxins and possibly more sensitive to the rewarding and addictive effects of alcohol and tobacco.

These vulnerabilities likely cause adolescents to be more susceptible to certain marketing influences. Adolescent impulsivity may cause them to use risky, addictive products and engage in other dangerous acts that are associated with thrill seeking and immediate gratification. It appears that adolescents are particularly likely to act impulsively when they are in negative mood states and that adolescents tend to experience negative mood states more frequently and intensely than either children or adults. Furthermore, adolescent self-consciousness and self-doubt may lead them to rely on consumption symbols for self-expression and self-worth and to manifest materialism to a greater extent than adults. For example, adolescents may purchase expensive branded products that may be unaffordable and/or unnecessary and may feel insecure if they cannot have such products.

Alcohol and cigarettes are of particular concern because adolescents who use these products face greater health and social risks than adult users, including, but not limited to, addiction. Furthermore, adolescents may be especially tempted to use heavily advertised, popular brands of alcohol and cigarettes because these brands may fulfill their needs for immediate gratification and thrill seeking and their need for high-status consumption symbols.

Current Regulatory Environment

Currently in the United States, no comprehensive federal legislation governs how products should be marketed to children or adolescents or how high-risk, addictive products, such as tobacco and alcohol, should be marketed. The United States relies primarily on state regulation and industry self-regulation. Most states signed the Tobacco Master Settlement Agreement (National Association of Attorneys General 1998), which has provisions to protect adolescents. Furthermore, the beer, wine, and distilled spirits' industries have voluntary marketing codes that attempt to safeguard adolescents (see Table 1) (Federal Trade Commission 2003).

Table 1. Reasons Adolescence Might Show Heightened Vulnerability to Marketing Efforts and Possible Remedies

Possible Reason For Vulnerability	Neurobiological Basis	Possible Remedies[a]	Examples of Remedies[b]
1. Adolescents are prone to risky, impulsive decisions and behaviors, which are further aggravated by their enhanced susceptibility to intense, negative mood swings.	Adolescents have strong urges and negative emotions due to puberty, and their cortical inhibitory control is not fully developed.	Restrict advertising and promotions for high-risk, addictive products that depict risky or impulsive behavior.	BI: Advertisements should not show excessive drinking, intoxication, drunk driving, or illegal or indecent acts.
2. Adolescents tend to be self-conscious and insecure, causing them to rely on consumption symbols for self-definition and self-worth, and they manifest other characteristics of materialism.	Adolescents have the emerging ability to think abstractly, which enhances both social awareness and social anxiety.	Restrict advertising and promotions for high-risk, addictive products that depict psychosocial or image benefits.	BI, MSA: Advertisements should not imply that smoking/drinking is essential for social or financial success or status.
3. Adolescents (versus adults) may be differentially harmed by the use of addictive products, particularly cigarettes and alcohol, that pose immediate and/or longer-term risks.	The adolescent brain undergoes massive structural changes and experience-dependent plasticity, which makes it especially vulnerable to products' toxic effects and possibly also their addictive effects.	Prohibit marketers of high-risk, addictive products from targeting youths or reaching large numbers of youths.	MSA: There should be no youth targeting and no cartoons or outdoor advertisements. BI: Advertisements are restricted to media with 70%+ adult audiences.

[a]Assumes that restrictions are designed to protect children and adolescents.
[b]BI = Beer Institute Advertising and Marketing Code (Federal Trade Commission 2003); MSA = Tobacco Master Settlement Agreement (National Association of Attorneys General 1998).

The alcohol industry seems sensitive to concerns that its product marketing might encourage impulsive and risky behavior, presumably because alcohol itself weakens cortical inhibitory control. The Beer Institute Advertising and Marketing Code (Federal Trade Commission 2003) prohibits advertising and marketing materials that depict excessive drinking, intoxication, drunk driving, illegal activity, lewd or indecent language or images, and sexual passion or promiscuity attributable to beer consumption. However, the Tobacco Master Settlement Agreement (National Association of Attorneys General 1998) and Cigarette Advertising and Promotion Code (Tobacco Institute 1990) do not prohibit the depiction of impulsive, risky, indecent, or illegal behavior in cigarette advertisements or promotions. Some cigarette advertisements indeed contain such depictions.

The Tobacco Master Settlement Agreement (National Association of Attorneys General 1998) prohibits both branded promotional merchandise and paid product placements, presumably because both activities facilitate the use of brands as consumption symbols. The Beer Institute prohibits these activities only when they are targeted at youths (Federal Trade Commission 2003). In addition, the Cigarette Advertising and Promotion Code (Tobacco Institute 1990, p. 3) states, "Cigarette ads should not suggest that smoking is essential to social prominence, distinction, success, or sexual attraction." Likewise, the Beer Institute Advertising and Marketing Code (Federal Trade Commission 2003, p. D-3) states, "Beer advertising and marketing materials should contain no claims or representations that individuals cannot obtain social, professional, educational, athletic, or financial success or status without beer consumption." However, note that cigarette and beer advertisements can associate product use with success and status. These restrictions apply only to advertisements that suggest that product use is essential for success or status.

The tobacco and alcohol industries also recognize that they cannot promote their products to people below the legal purchase age, which is 21 years for alcohol and 18 years for tobacco in the United States. The Tobacco Master Settlement Agreement (National Association of Attorneys General 1998) states that firms cannot target youths (under age 18) either directly or indirectly. As a result, most major tobacco firms have agreed not to advertise in magazines in which youths constitute 15% or more of the readership (Hamilton et al. 2002). Philip Morris has also agreed not to advertise in magazines with readerships of two million or more youths. The Beer Institute Advertising and Marketing Code (Federal Trade Commission 2003) requires placement in media in which 70% or more of the audience is expected to be of legal purchase age (age 21 or older).

A Move Toward Comprehensive Federal Regulation

Congress may want to consider comprehensive regulations to protect children and adolescents from advertising and promotions for high-risk, addictive products. As this review shows, the scientific evidence that could be used to justify such regulations is mounting. A first step might be to identify addictive products that pose a higher risk to children and adolescents than to adults (e.g., tobacco, alcohol). Placement standards can be established to ensure that advertising and promotions for these products do not appear in media that reach large numbers of youths and/or a higher percentage of youths than adults. The U.S. Census Bureau estimates that in 2003, 26% of the population was under age 18, and 29% was under age 21 (see http://factfinder.census.gov). If a medium reaches more youths than would be expected given these percentages, it presumably has a differential appeal to youths and should not be used.

Ad content restrictions may also be useful and justifiable. Policy officials may want to restrict advertisements for high-risk, addictive products that depict risky or impulsive behavior (e.g., product use behavior) or that depict psychosocial benefits (e.g., stature, sex appeal; see Table 1). Such restrictions might apply to all media or just to youth-oriented media that reach a high percentage and/or a large number of adolescents. A different and perhaps simpler approach could require advertisements for high-risk, addictive products to use a text-only, black-and-white tombstone format in all media or at least in youth-oriented media (Kelly, Slater, and Karan 2002; U.S. Department of Health and Human Services 1996). Policy officials should also consider requiring firms to report on their compliance with media placement and/or content standards.

Some useful standards are already included in the cigarette and alcohol marketing codes. Reliance on industry self-regulation has several advantages; for example, regulatory costs are lower and are borne primarily by the industry rather than by taxpayers. However, self-regulation also has several limitations. An industry's self-imposed rules may be too weak or have loopholes. The U.S. beer, wine, and distilled spirits industries initially permitted their advertisements to be placed in magazines in which just 50% of readers were of legal drinking age, and only recently have they adopted a more stringent standard as a result of congressional pressure (Federal Trade Commission 2003). Other problems with self-regulation include limited data on compliance, possible noncompliance by some firms, and limited enforcement and punishment mechanisms.

The California attorney general recently brought a law suit against R.J. Reynolds, alleging that the tobacco firm continued to target youth, particularly through its media placements (*People of the State of California v. R.J. Reynolds Tobacco Company* 2002). The firm was found to be in violation of the Master Settlement Agreement, but that agreement applies only to major tobacco firms and to the signatory states. As a society, the United States may decide that its young people deserve more protection than what they now have, which is nothing more than a patchwork of limited state and industry protections. Another impetus for change with respect to tobacco is that the United States recently signed the world tobacco treaty, which strongly encourages, if not mandates, comprehensive regulation of tobacco marketing (World Health Organization 2003).

Future Research Directions

Direct Evidence of Adolescents' Differential Receptivity to Advertising

Although there is converging evidence that indicates that adolescents may be more receptive to image advertising than adults, there is little direct evidence. Controlled experiments should examine this issue. In our review, we found only one study that directly assessed age-related differences in image ad receptivity: Pollay and colleagues' (1996) econometric study of cigarette ad response. The literature on the development of interest in brands and consumption symbolism is conflicting as to whether such interest peaks in early adolescence (Simpson, Douglas, and Schimmel 1998), late adolescence (Moore and Stephens 1975), or early adulthood (Belk, Bahn, and Mayer 1982). Thus, we recommend that studies be conducted that directly compare adolescents' with adults' image ad receptivity, including experiments in which ad exposure is manipulated for each age group. To control for potential age-related confounds, covariates should be included, such as prior product use and product interest. If age-related differences in ad response are found, possible causes of such differences should be investigated, such as self-consciousness, social anxiety, impulsivity, risk seeking, sensation seeking, and/or negative affect.

Moderators of Adolescents' Advertising Receptivity

We also recommend research on whether adolescents might be particularly receptive to certain types of advertising images and whether their receptivity might be moderated by individual differences. To our knowledge, virtually no research has been conducted on these topics (for an exception, see Kelly, Slater, and Karan 2002). This research would help determine whether certain types of advertising are particularly problematic and warrant special restrictions and/or whether certain types of adolescents are especially vulnerable and warrant targeted interventions.

We have argued that one reason adolescents may show heightened vulnerability to advertising is that they are prone to impulsive, thrill-seeking behavior. Correspondingly, it might be expected that adolescents respond more favorably to advertisements that depict impulsive, thrill-seeking acts than to other ad types. Adolescents may be particularly responsive to advertisements that depict impulsive or risky acts when they are in a negative mood state and, thus, prone to acting on impulse to obtain immediate gratification or when they are in a high-arousal state and distracted. Adolescents who are sensation seekers or risk seekers may be even more responsive than other adolescents, particularly given a negative mood or high arousal. Adults may not manifest any preferential response to this type of advertising. Because several questions remain unanswered, we believe that a series of studies should be conducted. Adolescent and adult responses should be compared, affective state should be induced (Gardner and Steinberg, in press), and personality traits should be measured to examine mediating and moderating effects. Furthermore, outcomes should be assessed not only in terms of ad response but also in terms of ad effects, such as viewers' intent to use the advertised product relative to a control or baseline.

It is also our contention that adolescents may show heightened vulnerability to advertising because they tend to be self-conscious and insecure. Accordingly, adolescents may be especially responsive to image or lifestyle advertisements that associate product use with psychosocial benefits (e.g., stature, sex appeal, impressing friends) compared with other ad types. Adolescents may be especially receptive to such image advertisements when they are induced to experience self-consciousness or social anxiety. Adolescents who are materialistic or experience social anxiety as a trait may be particularly vulnerable. Adults may show no differential response to such image advertisements relative to other ad types. These issues have not been directly addressed, and therefore further work is necessary.

We also suggest that researchers examine whether one of the two factors we just discussed, impulsivity or self-consciousness, is more important than the other in affecting adolescents' response to advertisements and/or promotions. The policy implications could be quite substantial. The advertising policy recommendations we presented previously (see Table 1) assume that both of these factors are influential. More specifically, we recommend that advertisements for high-risk, addictive products should be prohibited from depicting impulsive or risky acts, or psychosocial or image benefits, particularly if the advertisements will be viewed by adolescents. However, it might not be necessary to restrict both types of advertisements; perhaps only one ad type merits restrictions. It would likely be easier to restrict advertisements depicting impulsive, risky acts than to restrict image advertisements depicting any type of psychosocial benefit.

Adolescent Decision Making in Real-World Contexts

Most studies of decision making take place in research laboratories and ask people to respond to hypothetical situations. As Steinberg and Cauffman (1996) note, however, this methodology minimizes the potential effects of psychosocial factors on judgment. Hypothetical situations have no consequences and do not require people to exercise responsibility or self-restraint. Studies that assess responses to hypothetical situations examine decision making in the absence of time pressure, emotional arousal, and coercion by others. In contrast, in real-world settings, adolescents make many decisions in the company of others or in other challenging situations that are likely to evoke impulsivity in people with little self-control. Gardner and Steinberg's (in press) recent research demonstrates the importance of the decision-making context. They find that adolescents take more risks in the presence of peers than when they are alone and that adolescents are more strongly affected by the presence of peers than adults. These findings cry out for more research examining adolescent decision making in real-world settings.

Recent advances in electronic diary technologies may be useful for designing research in decision making in real-world contexts and possible interactions with individual difference variables. Researchers have used electronic diary

programs installed on handheld computers to signal adolescents to report their current emotional state, environmental context, and activities multiple times each day (Henker et al. 2002). Researchers could make further use of this technology to contrast age groups and people who vary on measures such as sensation seeking, depression, or social anxiety. They could also examine how adolescents' cost and benefit ratings change across different real-world contexts, such as when adolescents are in groups versus when they are alone, when they are excited or depressed, or when they are deciding what to buy at home versus what to buy at the mall.

Targeted Media Literacy Interventions for Adolescents

It is important to remember that adolescence is a time of both opportunities and vulnerabilities. It may be possible to train adolescents to view image advertising and the more subtle product placement approaches with the skepticism they often direct at authority figures (Friestad and Wright 1994; Wright 1986). The effectiveness of such media literacy training needs to be evaluated. Tailored interventions may be necessary for vulnerable subgroups of adolescents, such as those who manifest higher risk taking and impulsive behavior and/or those who suffer from acute self-consciousness and social anxiety.

Currently, most interventions aimed at improving adolescent decision making focus on increasing their knowledge of the costs and benefits of particular decisions. However, recent research shows that under conditions of high arousal or social coercion, such knowledge simply may not come to mind. Thus, further research is necessary to identify the types of education or interventions that are likely to be effective in circumstances that elicit high arousal or hot cognition. That is, there must be a better understanding of the conditions under which adolescents' knowledge of costs and benefits is likely to be accessible or inaccessible and interventions that may increase the accessibility of relevant knowledge in real-world circumstances.

Adolescent Versus Adult Brain Response to Advertisements and Brands

The neurological mechanisms underlying the human brain's response to advertisements and brands are not yet understood for either adolescents or adults. Basic research should be conducted among both age groups and then to investigate possible age-related differences. In particular, researchers should examine whether brain response to marketing stimuli differs between adults and adolescents, how responses may be influenced by arousal, and whether there are age-related differences in response given high arousal. A recent fMRI study in adults has demonstrated that the brain regions that are recruited in choosing between culturally familiar tastes depend on whether brand information is salient (McClure et al. 2004). When blind tasting was conducted and choices were based purely on sensory information, participants relied on regions of the brain that are linked to reward, such as the ventromedial prefrontal cortex. However, when brand information was presented during choice, there was a marked shift in regional activation such that brain regions known to be involved in cognitive control became active. Similar fMRI studies would be helpful in defining the neural circuitry underlying such decision-making processes in adolescents and in characterizing age-related differences.

More research is also necessary to define further the influences of the dopamine system on adolescent decision making, especially in response to arousing stimuli such as advertising. The brain chemical dopamine has been studied for decades, and it clearly plays an important role in "stamping in" the salience of environmental cues (Grace and Rosenkranz 2002; Wise 2004). This brain system is extremely late to mature and undergoes substantial changes during adolescence. Thus, adolescents may respond to cues, including advertising, differently from adults. Finally, animal studies are necessary to characterize more fully the neural circuitry involved in adolescent decision-making and reward processes. These studies will complement human imaging and behavioral studies and allow the linking of changes in neural structure to immature adolescent brain function. Studies of innate differences may provide further evidence that adolescents are biologically vulnerable and, thus, should be protected from marketing practices that may seriously endanger their health and well-being.

References

Adleman, Nancy E., Vinod Menon, Christine M. Blasey, Christopher D. White, Ilana S. Warsofsky, Gary H. Glover, and Allan L. Reiss (2002), "A Developmental fMRI Study of the Stroop Color-Word Task," *NeuroImage*, 16 (1), 61–75.

Adolphs, Ralph (2001), "The Neurobiology of Social Cognition," *Current Opinion in Neurobiology*, 11 (2), 231–39.

Andersen, Susan L. (2003), "Trajectories of Brain Development: Point of Vulnerability or Window of Opportunity?" *Neuroscience and Biobehavior Reviews*, 27 (1–2), 3–18.

———, Andrew T. Thompson, Mark Rutstein, John C. Hostetter, and Martin H. Teicher (2000), "Dopamine Receptor Pruning in Prefrontal Cortex During the Periadolescent Period in Rats," *Synapse*, 37 (2), 167–69.

Arnett, Jeffrey Jensen (1999), "Adolescent Storm and Stress, Reconsidered," *American Psychologist*, 54 (5), 317–26.

——— (2000), "Optimistic Bias in Adolescent and Adult Smokers and Nonsmokers," *Addictive Behaviors*, 25 (4), 625–32.

Arnsten, Amy F. (1997), "Catecholamine Regulation of the Prefrontal Cortex," *Journal of Psychopharmacology*, 11 (2), 151–62.

Auchus, Richard J. and William E. Rainey (2004), "Adrenarche: Physiology, Biochemistry and Human Disease," *Clinical Endocrinology*, 60 (3), 288–96.

Barton, John, Laurie Chassin, Clark C. Presson, and Steven J. Sherman (1982), "Social Image Factors as Motivators of Smoking Initiation in Early and Middle Adolescence," *Child Development*, 53 (6), 1499–1511.

Belk, Russell W., Kenneth D. Bahn, and Robert N. Mayer (1982), "Developmental Recognition of Consumption Symbolism," *Journal of Consumer Research*, 9 (1), 4–17.

Benes, Francine M., Jill Bolte Taylor, and Miles C. Cunningham (2000), "Convergence and Plasticity of Monoaminergic Systems in the Medial Prefrontal Cortex During the Postnatal Period:

Implications for the Development of Psychopathology," *Cerebral Cortex*, 10 (10), 1014–1027.

Beyth-Marom, Ruth, Laurel Austin, Baruch Fischhoff, Claire Palmgren, and Marilyn Jacobs-Quadrel (1993), "Perceived Consequences of Risky Behaviors: Adults and Adolescents," *Developmental Psychology*, 29 (3), 549–63.

Blanken, Ann J. (1993), "Measuring Use of Alcohol and Other Drugs Among Adolescents," *Public Health Reports*, 108 (Supplement 1), 25–30.

Bonnie, Richard J. and Mary Ellen O'Connell (2004), *Reducing Underage Drinking*. Washington, DC: National Academies Press.

Boush, David M., Marian Friestad, and Gregory M. Rose (1994), "Adolescent Skepticism Toward TV Advertising and Knowledge of Advertiser Tactics," *Journal of Consumer Research*, 21 (1), 165–75.

Breslau, Naomi and Edward L. Peterson (1996), "Smoking Cessation in Young Adults: Age at Initiation of Cigarette Smoking and Other Suspected Influences," *American Journal of Public Health*, 86 (2), 214–20.

Brooks-Gunn, Jeanne, Julia A. Graber, and Roberta L. Paikoff (1994), "Studying Links Between Hormones and Negative Affect: Models and Measures," *Journal of Research on Adolescence*, 4 (4), 469–86.

Brown, Bradford B. (1990), "Peer Groups and Peer Culture," in *At the Threshold: The Developing Adolescent*, S. Shirley Feldman and Glen R. Elliott, eds. Cambridge, MA: Harvard University Press.

Brown, Sandra A., Susan F. Tapert, Eric Granholm, and Dean C. Delis (2000), "Neurocognitive Functioning of Adolescents: Effects of Protracted Alcohol Use," *Alcoholism: Clinical and Experimental Research*, 24 (2), 164–71.

Buchanan, Christy M., Jacquelynne S. Eccles, and Jill B. Becker (1992), "Are Adolescents the Victims of Raging Hormones? Evidence for Activational Effects of Hormones on Moods and Behavior at Adolescence," *Psychological Bulletin*, 111 (1), 62–107.

Burton, Dee, Steve Sussman, William B. Hansen, C. Anderson Johnson, and Brian R. Flay (1989), "Image Attributions and Smoking Intentions Among Seventh Grade Students," *Journal of Applied Social Psychology*, 19 (8), 656–64.

Cauffman, Elizabeth and Laurence Steinberg (1995), "The Cognitive and Affective Influences on Adolescent Decision-Making," *Temple Law Review*, 68, 1763–89.

——— and ——— (2000), "(Im)maturity of Judgment in Adolescence: Why Adolescents May Be Less Culpable Than Adults," *Behavioral Sciences and the Law*, 18 (6), 741–60.

Chambers, R. Andrew, Jane R. Taylor, and Marc N. Potenza (2003), "Developmental Neurocircuitry of Motivation in Adolescents: A Critical Period of Addiction Vulnerability," *American Journal Psychiatry*, 160 (6), 1041–1052.

Chassin, Laurie, Clark C. Presson, Steven J. Sherman, Eric Corty, and Richard Olshavsky (1981), "Self-Images and Cigarette Smoking in Adolescence," *Personality and Social Psychology Bulletin*, 7 (4), 670–76.

———, ———, ———, and Debra A. Edwards (1990), "The Natural History of Cigarette Smoking: Predicting Young-Adult Smoking Outcomes from Adolescent Smoking Patterns," *Health Psychology*, 9 (6), 701–716.

Clark, David M. and Freda McManus (2002), "Information Processing in Social Phobia," *Biological Psychiatry*, 51 (1), 92–100.

Cohen, Joel B. (2000), "Playing to Win: Marketing and Public Policy at Odds over Joe Camel," *Journal of Public Policy & Marketing*, 19 (Fall), 155–67.

Cohn, Lawrence D., Susan Macfarlane, Claudia Yanez, and Walter K. Imai (1995), "Risk-Perception: Differences Between Adolescents and Adults," *Health Psychology*, 14 (3), 217–22.

Colder, Craig R. and Eric Stice (1998), "A Longitudinal Study of the Interactive Effects of Impulsivity and Anger on Adolescent Problem Behavior," *Journal of Youth and Adolescence*, 27 (3), 255–74.

Cook, Philip J. and Michael J. Moore (1993), "Drinking and Schooling," *Journal of Health Economics*, 12, 411–29.

Crews, Fulton T., Christopher J. Braun, Blair Hoplight, Robert C. Switzer III, and Darin J. Knapp (2000), "Binge Ethanol Consumption Causes Differential Brain Damage in Young Adolescent Rats Compared with Adult Rats," *Alcoholism: Clinical and Experimental Research*, 24 (11), 1712–23.

Cunningham, Miles Gregory, Sujoy Bhattacharyya, and Francine M. Benes (2002), "Amygdalo-Cortical Sprouting Continues into Early Adulthood: Implications for the Development of Normal and Abnormal Function During Adolescence," *Journal of Comparative Neurology*, 453 (2), 116–30.

Dahl, Ronald E. (2004), "Adolescent Brain Development: Vulnerabilities and Opportunities: Keynote Address," in *Adolescent Brain Development: Vulnerabilities and Opportunities*, Vol. 1021, Ronald E. Dahl and Linda Patia Spear, eds. New York: Annals of the New York Academy of Sciences, 1–22.

Davis, Michael and Paul J. Whalen (2001), "The Amygdala: Vigilance and Emotion," *Molecular Psychiatry*, 6 (1), 13–34.

Diamond, Adele (2000), "Close Interrelation of Motor Development and Cognitive Development and of the Cerebellum and Prefrontal Cortex," *Child Development*, 71 (1), 44–56.

DiFranza, Joseph R., Judith A. Savageau, Nancy A. Rigotti, K. Fletcher, Judith K. Ockene, Ann D. McNeill, Mardia Coleman, and C. Wood (2002), "Development of Symptoms of Tobacco Dependence in Youths: 30 Month Follow Up Data from the DANDY Study," *Tobacco Control*, 11 (3), 228–35.

Durston, Sarah, Hilleke E. Hulshoff Pol, B.J. Casey, Jay N. Giedd, Jan K. Buitelaar, and Herman van Engeland (2001), "Anatomical MRI of the Developing Human Brain: What Have We Learned?" *Journal of the American Academy of Child & Adolescent Psychiatry*, 40 (9), 1012–1020.

Erikson, Erik H. (1968), *Identity: Youth and Crisis*. New York: W.W. Norton.

Ernst, Monique, Steven J. Grant, Edythe D. London, Carlo S. Contoreggi, Alane S. Kimes, and Loretta Spurgeon (2003), "Decision Making in Adolescents with Behavior Disorders and Adults with Substance Abuse," *American Journal of Psychiatry*, 160 (1), 33–42.

Eveleth, Phyllis B. and James Mourilyan Tanner (1990), *Worldwide Variation in Human Growth*, 2d ed. Cambridge, UK: Cambridge University Press.

Everitt, Barry J., Rrudolf N. Cardinal, John A. Parkinson, and Trevor W. Robbins (2003), "Appetitive Behavior: Impact of Amygdala-Dependent Mechanisms of Emotional Learning," *Annals of the New York Academy of Sciences*, 985, 233–50.

Federal Trade Commission, A Report to Congress (2003), "Alcohol Marketing and Advertising," (accessed July 18, 2005), [available at http://www.ftc.gov/os/2003/09/alcohol08report.pdf].

Fingerhut, Lois A. and Margaret Warner (1997), "Injury Chartbook, Health United States 1996-97," (accessed July 16, 2005), [available at http://www.cdc.gov/nchs/data/hus/hus97cht.pdf].

Fischhoff, Baruch, Andrew M. Parker, Waendi Bruine de Bruin, Julie Downs, Claire Palmgren, Robyn Dawes, and Charles F. Manski (2000), "Teen Expectations for Significant Life Events," *Public Opinion Quarterly*, 64 (2), 189–205.

Folkman, Susan, Richard S. Lazarus, Scott Pimley, and Jill Novacek (1987), "Age Differences in Stress and Coping Processes," *Psychology and Aging*, 2 (2), 171–84.

Foster, Susan E., Roger D. Vaughan, William H. Foster, and Joseph A. Califano Jr. (2003), "Alcohol Consumption and Expenditures for Underage Drinking and Adult Excessive Drinking," *Journal of American Medical Association*, 289 (8), 989–95.

Friestad, Marian and Peter Wright (1994), "The Persuasion Knowledge Model: How People Cope with Persuasion Attempts," *Journal of Consumer Research*, 21 (1), 1–31.

Furby, Lita and Ruth Beyth-Marom (1992), "Risk Taking in Adolescence: A Decision-Making Perspective," *Developmental Review*, 12 (1), 1–44.

Gardner, M. and Laurence Steinberg (in press), "Risky Decision-Making in Adolescence and Adulthood: An Experimental Study," *Developmental Psychology*, forthcoming.

Giedd, Jay N. (2004), "Structural Magnetic Resonance Imaging of the Adolescent Brain," *Annals of the New York Academy of Sciences*, 1021 (1), 77–85.

Gogtay, Nitin, Jay N. Giedd, Leslie Lusk, Kiralee M. Hayashi, Deaanna Greenstein, A. Catherine Vaituzis, Tom F. Nugent III, David H. Herman, Liv S. Clasen, Arthur W. Toga, Judith L. Rapoport, and Paul M. Thompson (2004), "Dynamic Mapping of Human Cortical Development During Childhood Through Early Adulthood," *Proceedings of the National Academy of Science (United States)*, 101 (21), 8174–79.

Goldman-Rakic, Patricia S., E. Christopher Muly III, and Graham V. Williams (2000), "$D_{(1)}$ Receptors in Prefrontal Cells and Circuits," *Brain Research Reviews*, 31 (2–3), 295–301.

Gomez, Francisco, Hani Houshyar, and Mary F. Dallman (2002), "Marked Regulatory Shifts in Gonadal, Adrenal, and Metabolic System Responses to Repeated Restraint Stress Occur Within a 3-Week Period in Pubertal Male Rats," *Endocrinology*, 143 (8), 2852–62.

Grace, Anthony A. and J. Amiel Rosenkranz (2002), "Regulation of Conditioned Responses of Basolateral Amygdala Neurons," *Physiology & Behavior*, 77 (4–5), 489–93.

Grant, Bridget F. and Deborah A. Dawson (1997), "Age at Onset of Alcohol Use and Its Association with DSM-IV Alcohol Abuse and Dependence: Results from the National Longitudinal Alcohol Epidemiologic Survey," *Journal of Substance Abuse*, 9, 103–110.

Greenberger, Ellen (1982), "Education and the Acquisition of Psychosocial Maturity," in *The Development of Social Maturity*, David C. McClelland, ed. New York: Irvington Publishers.

Gross, James J., Laura L. Carstensen, Monisha Pasupathi, Angie Y.C. Hsu, Jeanne Tsai, and Carina Götestam Skorpen (1997), "Emotion and Aging: Experience, Expression, and Control," *Psychology and Aging*, 12 (4), 590–99.

Guo, Jie, Linda M. Collins, Karl G. Hill, and J. David Hawkins (2000), "Developmental Pathways to Alcohol Abuse and Dependence in Young Adulthood," *Journal of Studies on Alcohol*, 61 (6), 799–808.

Hamann, Stephan, Rebecca A. Herman, Carla L. Nolan, and Kim Wallen (2004), "Men and Women Differ in Amygdala Response to Visual Sexual Stimuli," *Nature Neuroscience*, 7 (4), 411–16.

Hamilton, William L., Diane M. Turner-Bowker, Carolyn C. Celebucki, and Gregory N. Connolly (2002), "Cigarette Advertising in Magazines: The Tobacco Industry Response to the Master Settlement Agreement and to Public Pressure," *Tobacco Control*, 11 (Supplement 2), 54–58.

Hastings, Gerard B. and Philip P. Aitken (1995), "Tobacco Advertising and Children's Smoking: A Review of the Evidence," *European Journal of Marketing*, 29 (11), 6–17.

Haxby, James V., Elizabeth A. Hoffman, and M. Ida Gobbini (2002), "Human Neural Systems for Face Recognition and Social Communication," *Biological Psychiatry*, 51 (1), 59–67.

Henker, Barbara, Carol K. Whalen, Larry D. Jamner, and Ralph J. Delfino (2002), "Anxiety, Affect, and Activity in Teenagers: Monitoring Daily Life with Electronic Diaries," *Journal of the American Academy of Child & Adolescent Psychiatry*, 41 (6), 660–70.

Herdt, Gilbert and Martha McClintock (2000), "The Magical Age of 10," *Archives of Sexual Behavior*, 29 (6), 587–606.

Herman-Giddens, Marcia E., Eric J. Slora, Richard C. Wasserman, Carlos J. Bourdony, Manju V. Bhapkar, Gary G. Koch, and Cynthia M. Hasemeier (1997), "Secondary Sexual Characteristics and Menses in Young Girls Seen in Office Practice: A Study from the Pediatric Research in Office Settings Network," *Pediatrics*, 99 (4), 505–512.

Hingson, Ralph and Donald Kenkel (2004), "Social, Health, and Economic Consequences of Underage Drinking," in *Reducing Underage Drinking: A Collective Responsibility*, Richard J. Bonnie and Ellen O'Connell, eds. Washington, DC: National Academies Press.

Holbrook, Morris B. and Robert M. Schindler (1989), "Some Exploratory Findings on the Development of Musical Tastes," *Journal of Consumer Research*, 16 (1), 119–24.

Holsen, Ingrid, Pal Kraft, and Joar Vitterso (2000), "Stability in Depressed Mood in Adolescence: Results from a 6-Year Longitudinal Panel Study," *Journal of Youth and Adolescence*, 29 (1), 61–78.

Huttenlocher, Peter R. (1979), "Synaptic Density in Human Frontal Cortex: Developmental Changes and Effects of Aging," *Brain Research*, 163 (2), 195–205.

Inhelder, Bärbel and Jean Piaget (1958), *The Growth of Logical Thinking from Childhood to Adolescence: An Essay on the Construction of Formal Operational Structures*. New York: Basic Books.

Isensee, Barbara, Hans-Ulrich Wittchen, Murray B. Stein, Michael Hofler, and Roselind Lieb (2003), "Smoking Increases the Risk of Panic: Findings from a Prospective Community Study," *Archives of General Psychiatry*, 60 (7), 692–700.

Jacobsen, Leslie K., John H. Krystal, W. Einar Mencl, Michael Westerveld, Stephen J. Frost, and Kenneth R. Pugh (2005), "Effects of Smoking and Smoking Abstinence on Cognition in Adolescent Tobacco Smokers," *Biological Psychiatry*, 57 (1), 56–66.

Jang, Mi-Hyeon, Min-Chul Shin, Sae-Bin Jung, Taeck-Hyun Lee, Geon-Ho Bahn, Yunhee Kim Kwon, Ee-Hwa Kim, and Chang-

Ju Kim (2002), "Alcohol and Nicotine Reduce Cell Proliferation and Enhance Apoptosis in Dentate Gyrus," *NeuroReport*, 13 (12), 1509–1513.

Johnston, Lloyd D., Patrick M. O'Malley, and Jerald G. Bachman (2003), "Monitoring the Future National Results on Adolescent Drug Use: Overview of Key Findings, 2002," NIH Publication No. 03-5374. Bethesda, MD: National Institute on Drug Abuse.

Joyce, Jeffrey N., S.G. Goldsmith, and Eugenia V. Gurevich (1997), "Limbic Circuits and Monoamine Receptors: Dissecting the Effects of Antipsychotics from Disease Processes," *Journal of Psychiatric Research*, 31 (2), 197–217.

Kandel, Denise B. and John A. Logan (1984), "Patterns of Drug Use from Adolescence to Young Adulthood: I. Periods of Risk for Initiation, Continued Use, and Discontinuation," *American Journal Public Health*, 74 (7), 660–66.

Kasser, Tim and Allen D. Kanner (2004), *Psychology and Consumer Culture: The Struggle for a Good Life in a Materialistic World*. Washington, DC: American Psychological Association.

Keating, Daniel P. (1990), "Adolescent Thinking," in *At the Threshold: The Developing Adolescent*, S. Shirley Feldman and Glen R. Elliott, eds. Cambridge, MA: Harvard University Press.

Kelley, Ann E. (2004), "Memory and Addiction: Shared Neural Circuitry and Molecular Mechanisms," *Neuron*, 44 (1), 161–79.

Kelly, Kathleen J., Michael Slater, and David Karan (2002), "Image Advertisements' Influence on Adolescents' Perceptions of the Desirability of Beer and Cigarettes," *Journal of Public Policy & Marketing*, 21 (2), 295–304.

Killgore, William D., Mika Oki, and Deborah A. Yurgelun-Todd (2001), "Sex-Specific Developmental Changes in Amygdala Responses to Affective Faces," *NeuroReport*, 12 (2), 427–33.

King, Charles, III, Michael Siegel, Carolyn Celebucki, and Gregory N. Connolly (1998), "Adolescent Exposure to Cigarette Advertising in Magazines: An Evaluation of Brand-Specific Advertising in Relation to Youth Readership," *Journal of the American Medical Association*, 279 (7), 516–20.

Klintsova, Anna Y. and William T. Greenough (1999), "Synaptic Plasticity in Cortical Systems," *Current Opinion in Neurobiology*, 9 (2), 203–208.

Koshibu, Kyoko, Pat Levitt, and Eric T. Ahrens (2004), "Sex-Specific, Postpuberty Changes in Mouse Brain Structures Revealed by Three-Dimensional Magnetic Resonance Microscopy," *NeuroImage*, 22 (4), 1636–45.

Lambe, Evelyn K., Leonid S. Krimer, and Patricia S. Goldman-Rakic (2000), "Differential Postnatal Development of Catecholamine and Serotonin Inputs to Identified Neurons in Prefrontal Cortex of Rhesus Monkey," *Journal of Neuroscience*, 20 (23), 8780–87.

Larson, Reed and Mark Ham (1993), "Stress and 'Storm and Stress' in Early Adolescence: The Relationship of Negative Events with Dysphoric Affect," *Developmental Psychology*, 29 (1), 130–40.

———, Giovanni Moneta, Maryse H. Richards, and Suzanne Wilson (2002), "Continuity, Stability, and Change in Daily Emotional Experience Across Adolescence," *Child Development*, 73 (4), 1151–65.

——— and Maryse H. Richards (1991), "Daily Companionship in Late Childhood and Early Adolescence: Changing Developmental Contexts," *Child Development*, 62 (2), 284–300.

——— and ——— (1994), *Divergent Realities: The Emotional Lives of Mothers, Fathers, and Adolescents*. New York: Basic Books.

Leslie, Frances, Sandra E. Loughlin, Ruihua Wang, Lilyanna Perez, Shahrdad Lotfipour, and James D. Belluzzia (2004), "Adolescent Development of Forebrain Stimulant Responsiveness: Insights from Animal Studies," *Annals of the New York Academy of Sciences*, 1021 (160–61), 148–59.

Levine, Linda J., Carol K. Whalen, Barbara Henker, and Larry D. Jamner (2005), "Looking Back on September 11, 2001: Appraised Impact and Memory for Emotions in Adolescents and Adults," *Journal of Adolescent Research*, 20 (4), 497–523.

Lewis, Catherine C. (1987), "Minors' Competence to Consent to Abortion," *American Psychologist*, 42 (1), 84–88.

Lewis, David A. (1997), "Development of the Prefrontal Cortex During Adolescence: Insights into Vulnerable Neural Circuits in Schizophrenia," *Neuropsychopharmacology*, 16 (6), 385–98.

Linn, Susan E. (2004), *Consuming Kids: The Hostile Takeover of Childhood*. New York: New Press.

Luna, Beatriz and John A. Sweeney (2004), "The Emergence of Collaborative Brain Function: fMRI Studies of the Development of Response Inhibition," *Annals of the New York Academy of Sciences*, 1021, 296–309.

———, Keith R. Thulborn, Douglas P. Munoz, Elisha P. Merriam, Krista E. Garver, Nancy J. Minshew, Matcheri S. Keshavan, Christopher R. Genovese, William F. Eddy, and John A. Sweeney (2001), "Maturation of Widely Distributed Brain Function Subserves Cognitive Development," *NeuroImage*, 13 (5), 786–93.

Lynch, Barbara S. and Richard J. Bonnie (1994), *Growing Up Tobacco Free: Preventing Nicotine Addiction in Children and Youths*. Washington, DC: National Academy Press.

Maggs, Jennifer L., David M. Almeida, and Nancy L. Galambos (1995), "Risky Business: The Paradoxical Meaning of Problem Behavior for Young Adolescents," *Journal of Early Adolescence*, 15 (3), 344–62.

Martin, Catherine A., Thomas H. Kelly, Mary Kay Rayens, Bethanie R. Brogli, Allen Brenzel, W. Jackson Smith, and Hatim A. Omar (2002), "Sensation Seeking, Puberty and Nicotine, Alcohol and Marijuana Use in Adolescence," *Journal of the American Academy of Child & Adolescent Psychiatry*, 41 (12), 1495–1502.

Martin, Mary C. and James W. Gentry (1997), "Stuck in the Model Trap: The Effects of Beautiful Models in Ads on Female Pre-Adolescents and Adolescents," *Journal of Advertising*, 26 (2), 19–33.

———, ———, and Ronald Paul Hill (1999), "The Beauty Myth and the Persuasiveness of Advertising: A Look at Adolescent Girls and Boys," in *Advertising to Children: Concepts and Controversies*, M. Carole Macklin and Les Carlson, eds. Thousand Oaks, CA: Sage Publications, 165–87.

——— and Patricia F. Kennedy (1993), "Advertising and Social Comparison: Consequences for Female Preadolescents and Adolescents," *Psychology and Marketing*, 10 (6), 513–30.

Masten, Ann S. (2004), "Regulatory Processes, Risk and Resilience in Adolescent Development," *Annals of the New York Academy of Sciences*, 1021, 301–319.

May, Janet K. and Ardis W. Koester (1985), "Clothing Purchase Practices of Adolescents," *Home Economics Research Journal*, 13 (3), 226–36.

McClintock, Martha K. and Gilbert Herdt (1996), "Rethinking Puberty: The Development of Sexual Attraction," *Current Directions in Psychological Science*, 5 (6), 178–83.

McClure, Samuel M., Jian Li, Damon Tomlin, Kim S. Cypert, Latane M. Montague, and P. Read Montague (2004), "Neural Correlates of Behavioral Preference for Culturally Familiar Drinks," *Neuron*, 44 (2), 379–87.

McNeal, James U. (1992), *Kids as Customers: A Handbook of Marketing to Children*. New York: Lexington Books.

Metcalfe, Janet and Walter Mischel (1999), "A Hot/Cool-System Analysis of Delay of Gratification: Dynamics of Willpower," *Psychological Review*, 106 (1), 3–19.

Millstein, Susan G. and Bonnie L. Halpern-Felsher (2002a), "Judgments About Risk and Perceived Invulnerability in Adolescents and Young Adults," *Journal of Research on Adolescence*, 12 (4), 399–422.

——— and ——— (2002b), "Perceptions of Risk and Vulnerability," *Journal of Adolescent Health*, 31 (Supplement 1), 10–27.

Moffitt, Terrie E. (1993), "Adolescence-Limited and Life-Course-Persistent Antisocial Behavior: A Developmental Taxonomy," *Psychological Review*, 100 (4), 674–701.

Moody, William J. (1998), "Control of Spontaneous Activity During Development," *Journal of Neurobiology*, 37 (1), 97–109.

Moore, Roy L. and Lowndes F. Stephens (1975), "Some Communication and Demographic Determinants of Adolescent Consumer Learning," *Journal of Consumer Research*, 2 (2), 80–92.

Moore, Susan and Eleonora Gullone (1996), "Predicting Adolescent Risk Behavior Using a Personalized Cost-Benefit Analysis," *Journal of Youth and Adolescence*, 25 (3), 343–59.

Moschis, George P. and Gilbert A. Churchill (1979), "An Analysis of the Adolescent Consumer," *Journal of Marketing*, 43 (Summer), 40–48.

National Association of Attorneys General (1998), "Master Settlement Agreement," (accessed July 18, 2005), [available at http://www.naag.org/issues/tobacco/index.php?pubsec=0&sdpid=919].

Neemann, Jennifer, Jon Hubbard, and Ann S. Masten (1995), "The Changing Importance of Romantic Relationship Involvement to Competence from Late Childhood to Late Adolescence," *Development and Psychopathology*, 7 (4), 727–50.

Nelson, Eric E., Erin B. McClure, Christopher S. Monk, Eric Zarahn, Ellen Leibenluft, Daniel S. Pine, and Monique Ernst (2003), "Developmental Differences in Neuronal Engagement During Implicit Encoding of Emotional Faces: An Event-Related fMRI Study," *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 44 (7), 1015–1024.

Newman, Sarah Winans (1999), "The Medial Extended Amygdala in Male Reproductive Behavior: A Node in the Mammalian Social Behavior Network," *Annals of the New York Academy of Sciences*, 877, 242–57.

Parsons, Jeffrey T., Alexander W. Siegel, and Jennifer H. Cousins (1997), "Late Adolescent Risk-Taking: Effects of Perceived Benefits and Perceived Risks on Behavioral Intentions and Behavioral Change," *Journal of Adolescence*, 20 (4), 381–92.

Pechmann, Cornelia and Susan J. Knight (2002), "An Experimental Investigation of the Joint Effects of Advertising and Peers on Adolescents' Beliefs and Intentions About Cigarette Consumption," *Journal of Consumer Research*, 29 (1), 5–19.

——— and Srinivasan Ratneshwar (1994), "The Effects of Anti-smoking and Cigarette Advertising on Young Adolescents' Perceptions of Peers Who Smoke," *Journal of Consumer Research*, 21 (2), 236–51.

People of the State of California v. R.J. Reynolds Tobacco Company (2002), Case No. GIC 764118, County of San Diego, Superior Court of California, (June 6).

Petersen, Anne C., Bruce E. Compas, Jeanne Brooks-Gunn, Mark Stemmler, Sydney Ey, and Kathryn E. Grant (1993), "Depression in Adolescence," *American Psychologist*, 48 (2), 155–68.

Philpot, Rex Montgomery, Kimberly A. Badanich, and Cheryl Kirstein (2003), "Place Conditioning: Age-Related Changes in the Rewarding and Aversive Effects of Alcohol," *Alcoholism: Clinical and Experimental Research*, 27 (4), 593–99.

Pierce, John P., Elizabeth A. Gilpin, David M. Burns, Elizabeth Whalen, Bradley Rosbrook, Donald Shopland, and Michael Johnson (1991), "Does Tobacco Advertising Target Young People to Start Smoking? Evidence from California," *Journal of the American Medical Association*, 266 (22), 3154–58.

Pine, Daniel S. (2001), "Affective Neuroscience and the Development of Social Anxiety Disorder," *Psychiatric Clinics of North America*, 24 (4), 689–705.

Pollay, Richard W., S. Siddarth, Michael Siegel, Anne Haddix, Robert K. Merritt, Gary A. Giovino, and Michael P. Eriksen (1996), "The Last Straw? Cigarette Advertising and Realized Market Shares Among Youths and Adults, 1979–1993," *Journal of Marketing*, 60 (April), 1–16.

Pucci, Linda G. and Michael Siegel (1999), "Exposure to Brand-Specific Cigarette Advertising in Magazines and Its Impact on Youth Smoking," *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 29 (5), 313–20.

Qin, Yulin, Cameron S. Carter, Eli M. Silk, V. Andrew Stenger, Kate Fissell, Adam Goode, and John R. Anderson (2004), "The Change of the Brain Activation Patterns as Children Learn Algebra Equation Solving," *Proceedings of the National Academy of Sciences (United States)*, 101 (15), 5686–91.

Quadrel, Marilyn J., Baruch Fischhoff, and Wendy Davis (1993), "Adolescent (In)Vulnerability," *American Psychologist*, 48 (2), 102–116.

Quart, Allissa (2004), *Branded: The Buying and Selling of Teenagers*. Cambridge, MA: Perseus Publishing.

Rankin, Jane L., David J. Lane, Frederick X. Gibbons, and Meg Gerrard (2000), "Adolescent Self-Consciousness: Longitudinal Age Changes and Gender Differences in Two Cohorts," *Journal of Research on Adolescence*, 14 (1), 1–21.

Richins, Marsha L. (1991), "Social Comparison and the Idealized Images of Advertising," *Journal of Consumer Research*, 18 (1), 71–83.

Rindfleisch, Aric, James E. Burroughs, and Frank Denton (1997), "Family Structure, Materialism, and Compulsive Consumption," *Journal of Consumer Research*, 23 (4), 312–25.

Romeo, Russell D., Susan J. Lee, Nara Chhua, Christina R. McPherson, and Bruce S. McEwen (2004), "Testosterone Cannot Activate an Adult-Like Stress Response in Prepubertal Male Rats," *Neuroendocrinology*, 79 (3), 125–32.

Rosso, Isabelle M., Ashley D. Young, Lisa A. Femina, and Deborah A. Yurgelun-Todd (2004), "Cognitive and Emotional Components of Frontal Lobe Functioning in Childhood and Adolescence," *Annals of the New York Academy of Sciences*, 1021, 355–62.

Rowe, Richard, Barbara Maughan, Carol M. Worthman, E. Jane Costello, and Adrian Angold (2004), "Testosterone, Antisocial

Behavior, and Social Dominance in Boys: Pubertal Development and Biosocial Interaction," *Biological Psychiatry*, 55 (5), 546–52.

Sapolsky, Robert M. (2003), "Stress and Plasticity in the Limbic System," *Neurochemical Research*, 28 (11), 1735–42.

Sen, Bisakha (2002), "Does Alcohol-Use Increase the Risk of Sexual Intercourse Among Adolescents? Evidence from the NLSY97," *Journal of Health Economics*, 21 (6), 1085–1093.

Shiv, Baba and Alexander Fedorikhin (1999), "Heart and Mind in Conflict: The Interplay of Affect and Cognition in Consumer Decision Making," *Journal of Consumer Research*, 26 (3), 278–92.

——— and ——— (2002), "Spontaneous Versus Controlled Influences of Stimulus-Based Affect on Choice Behavior," *Organizational Behavior and Human Decision Processes*, 87 (2), 342–70.

Simpson, Linda, Sara Douglas, and Julie Schimmel (1998), "Tween Consumers: Catalog Clothing Purchase Behavior," *Adolescence*, 33 (131), 637–44.

Sisk, Cheryl L. and Douglas L. Foster (2004), "The Neural Basis of Puberty and Adolescence," *Nature Neuroscience*, 7 (10), 1040–1047.

Slawecki, Craig J., Allison Gilder, Jennifer Roth, and Cindy L. Ehlers (2003), "Increased Anxiety-Like Behavior in Adult Rats Exposed to Nicotine as Adolescents," *Pharmacology Biochemistry and Behavior*, 75 (2), 355–61.

———, Annika Thorsell, and Cindy L. Ehlers (2004), "Long-Term Neurobehavioral Effects of Alcohol or Nicotine Exposure in Adolescent Animal Models," *Annals of the New York Academy of Sciences*, 1021, 448–52.

Slotkin, Theodore A. (2002), "Nicotine and the Adolescent Brain: Insights from an Animal Model," *Neurotoxicology and Teratology*, 24 (3), 369–84.

Snyder, Howard N. and Melissa Sickmund (1999), *Juvenile Offenders and Victims: 1999 National Report*, U.S. Department of Justice, ed. Washington, DC: Office of Juvenile Justice and Delinquency Prevention.

Solomon, Michael R. (1983), "The Role of Products as Social Stimuli: A Symbolic Interactionism Perspective," *Journal of Consumer Research*, 10 (3), 319–29.

——— (1992), *Consumer Behavior*. Needham Heights, MA: Allyn & Bacon.

Sowell, Elizabeth R., Paul M. Thompson, Kevin D. Tessner, and Arthur W. Toga (2001), "Mapping Continued Brain Growth and Gray Matter Density Reduction in Dorsal Frontal Cortex: Inverse Relationships During Postadolescent Brain Maturation," *Journal of Neuroscience*, 21 (22), 8819–29.

Spear, Linda P. (2000), "The Adolescent Brain and Age-Related Behavioral Manifestations," *Neuroscience & Biobehavioral Reviews*, 24 (4), 417–63.

Spurr, Jane M. and Lusia Stopa (2002), "Self-Focused Attention in Social Phobia and Social Anxiety," *Clinical Psychology Review*, 22 (7), 947–75.

Steinberg, Laurence D. (2002), *Adolescence*, 6th ed. Boston: McGraw-Hill.

——— and Elizabeth Cauffman (1996), "Maturity of Judgment in Adolescence: Psychosocial Factors in Adolescent Decision Making," *Law and Human Behavior*, 20 (3), 249–72.

———, Ronald E. Dahl, Daniel P. Keating, David L. Kupfer, Ann S. Masten, and Daniel S. Pine (in press), "The Study of Developmental Psychopathology in Adolescence: Integrating Affective Neuroscience with Study of Context," in *Handbook of Developmental Psychopathology*, Dante Cicchetti, ed. New York: John Wiley & Sons, forthcoming.

——— and Elizabeth S. Scott (2003), "Less Guilty by Reason of Adolescence: Development Immaturity, Diminished Responsibility, and the Juvenile Death Penalty," *American Psychologist*, 58 (12), 1009–1018.

——— and Susan B. Silverberg (1986), "The Vicissitudes of Autonomy in Early Adolescence," *Child Development*, 57 (4), 841–51.

Taioli, Emanuela and Ernst L. Wynder (1991), "Effect of the Age at Which Smoking Begins on Frequency of Smoking in Adulthood," *New England Journal of Medicine*, 325 (13), 968–69.

Tapert, Susan F., Gregory G. Brown, Sandra S. Kindermann, Erick H. Cheung, Lawrence R. Frank, and Sandra A. Brown (2001), "fMRI Measurement of Brain Dysfunction in Alcohol-Dependent Young Women," *Alcoholism: Clinical and Experimental Research*, 25 (2), 236–45.

Tarazi, Frank I. and Ross J. Baldessarini (2000), "Comparative Postnatal Development of Dopamine D(1), D(2) and D(4) Receptors in Rat Forebrain," *International Journal of Developmental Neuroscience*, 18 (1), 29–37.

Tercyak, Kenneth P., Paula Goldman, Ashlyn Smith, and Janet Audrain (2002), "Interacting Effects of Depression and Tobacco Advertising Receptivity on Adolescent Smoking," *Journal of Pediatric Psychology*, 27 (2), 145–54.

Thompson, Ross A. (1994), "Emotion Regulation: A Theme in Search of Definition," in *Monographs of the Society for Research in Child Development*, Vol. 59, No. 2–3, Nathan A. Fox, ed. Chicago: University of Chicago Press, 25–52.

Tice, Dianne M., Ellen Bratslavsky, and Roy F. Baumeister (2001), "Emotional Distress Regulation Takes Precedence over Impulse Control: If You Feel Bad, Do It!" *Journal of Personality and Social Psychology*, 80 (1), 53–67.

Tobacco Institute (1990), "Cigarette Advertising and Promotion Code," (accessed July 18, 2005), [available at http://www.tobaccoinstitute.com/].

Trimpop, Rudiger M., John H. Kerr, and Bruce D. Kirkcaldy (1999), "Comparing Personality Constructs of Risk-Taking Behavior," *Personality and Individual Differences*, 26 (2), 237–54.

Tseng, Kuei Y. and Patricio O'Donnell (2005), "Post-Pubertal Emergence of Prefrontal Cortical Up States Induced by D1-NMDA Co-Activation," *Cerebral Cortex*, 15 (1), 49–57.

U.S. Centers for Disease Control and Prevention (1994), "Changes in the Cigarette Brand Preferences of Adolescent Smokers: United States, 1989-1993," *Morbidity and Mortality Weekly Report*, (August 19), 577–81.

U.S. Department of Health and Human Services (1995a), "The Effects of the Mass Media on the Use and Abuse of Alcohol," in *U.S. Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism, Research Monograph 28*, Susan E. Martin, ed. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

——— (1995b), "Regulations Restricting the Sale and Distribution of Cigarettes and Smokeless Tobacco Products to Protect Children and Adolescents; Proposed Rule," *Federal Register*, 60 (155), 41314–75.

——— (1996), "Regulations Restricting the Sale and Distribution of Cigarettes and Smokeless Tobacco Products to Protect Children and Adolescents; Final Rule," *Federal Register*, 61 (168), 44396–45318.

Viau, Victor, Brenda Bingham, Jennifer Davis, Patricia Lee, and Margaret Wong (2005), "Gender and Puberty Interact on the Stress-Induced Activation of Parvocellular Neurosecretory Neurons and Corticotropin-Releasing Hormone Messenger Ribonucleic Acid Expression in the Rat," *Endocrinology*, 146 (1), 137–46.

Waelti, Pascale, Anthony Dickinson, and Wolfram Schultz (2001), "Dopamine Responses Comply with Basic Assumptions of Formal Learning Theory," *Nature*, 412 (6842), 43–48.

Wakefield, Melanie, Brian R. Flay, Mark Nichter, and Gary A. Giovino (2003), "Role of the Media in Influencing Trajectories of Youth Smoking," *Addiction*, 98 (Supplement 1), 79–103.

Walker, Elaine F., Zainab Sabuwalla, and Rebecca Huot (2004), "Pubertal Neuromaturation, Stress Sensitivity, and Psychopathology," *Development and Psychopathology*, 16 (4), 807–824.

Wechsler, Henry, George W. Dowdall, Gretchen Maenner, Jeana Gledhill-Hoyt, and Hang Lee (1998), "Changes in Binge Drinking and Related Problems Among American College Students Between 1993 and 1997. Results of the Harvard School of Public Health College Alcohol Study," *Journal of American College Health*, 47 (2), 57–68.

Weinstein, Neil D. (1980), "Unrealistic Optimism About Future Life Events," *Journal of Personality and Social Psychology*, 39 (5), 806–820.

Whalen, Carol K., Larry D. Jamner, Barbara Henker, and Ralph J. Delfino (2001), "Smoking and Moods in Adolescents with Depressive and Aggressive Dispositions: Evidence from Surveys and Electronic Diaries," *Health Psychology*, 20 (2), 99–111.

Wise, Roy A. (2004), "Dopamine, Learning and Motivation," *Nature Reviews Neuroscience*, 5 (6), 483–94.

Wood, Phillip K., Kenneth J. Sher, Darin J. Erickson, and Kurt A. DeBord (1997), "Predicting Academic Problems in College from Freshman Alcohol Involvement," *Journal of Studies on Alcohol*, 58 (2), 200–210.

World Health Organization (2003), "WHO Framework Convention on Tobacco Control," (accessed July 18, 2005), [available at http://www.who.int/gb/fctc/PDF/inb6/einb65.pdf].

Wright, Peter (1986), "Schemer Schema: Consumers' Intuitive Theories About Marketers' Influence Tactics," in *Advances in Consumer Research*, Vol. 13, Richard Lutz, ed. Provo, UT: Association for Consumer Research, 1–3.

Wulfert, Edelgard, Jennifer A. Block, Elizabeth Santa Ana, Monica L. Rodriguez, and Melissa Colsman (2002), "Delay of Gratification: Impulsive Choices and Problem Behaviors in Early and Late Adolescence," *Journal of Personality*, 70 (4), 533–52.

Zollo, Peter (2004), *Getting Wiser to Teens: More Insights into Marketing to Teenagers*. Ithaca, NY: New Strategist Publications.

Zuckerman, Marvin (1979), *Sensation Seeking: Beyond the Optimal Level of Arousal*. Hillsdale, NJ: Lawrence Erlbaum Associates.