**Transitions Into Underage and Problem Drinking: Developmental Processes and Mechanisms Between 10 and 15 Years of Age**

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**ABSTRACT**

Numerous developmental changes occur across levels of personal organization (eg, changes related to puberty, brain and cognitive-affective structures and functions, and family and peer relationships) in the age period of 10 to 15 years. Furthermore, the onset and escalation of alcohol use commonly occur during this period. This article uses both animal and human studies to characterize these multilevel developmental changes. The timing of and variations in developmental changes are related to individual differences in alcohol use. It is proposed that this integrated developmental perspective serve as the foundation for subsequent efforts to prevent and to treat the causes, problems, and consequences of alcohol consumption.

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During the developmental period spanning 10 to 15 years of age, considerable changes occur in biological, cognitive, emotional, and social processes, as well as physical and social contexts. These changes occur across different levels of personal organization, including overt physical appearance (eg, increases in physical size), refinements in the structure and function of the central nervous system (CNS), and maturational changes in the internal hormonal and neurophysiological milieus. By age 10, most adolescents have begun the rapid changes of puberty, as defined by changes in secretory patterns of the gonadal steroids. These hormonal changes are accompanied by dramatic changes in height as well as readily visible changes in body composition and secondary sexual characteristics, with overt physical differences between the genders becoming increasingly apparent.

Whereas some personal changes are closely aligned with chronological age, such as attendance at elementary, middle, or high school, others are more closely tied to variations in the timing of events (pubertal onset) and/or developmental stages, such as interest in the opposite gender and relative peer influences. As a result, different aspects of personal development take place at different times, and different individuals mature in different dimensions at different times. For example, pubertal development may occur at a different time than does the social-cognitive development necessary for intimate relationships. The physical and emotional changes associated with pubertal development occur over a considerable age range. Adolescents who begin puberty relatively early may experience processes postulated to be associated with puberty, such as heightened emotional states and greater influences of external stimuli, sooner than they have the cognitive and emotional abilities to control consistently behaviors that develop as a function of the maturation of brain regions and collaborative brain networks.

The average age of puberty has decreased over the past century, whereas the average age of assumption of adult roles has increased because of prolonged education by more youths and later age of initial marriage. These changes have heightened the significance of understanding adolescence along the multiple continua of physical, cognitive, social, and environmental changes.

Table 1 summarizes a number of the developmental periods, transitions, contexts, and tasks confronted during the period of 10 to 15 years of age. This period is commonly referred to as early adolescence and the beginning of middle adolescence (beginning at ~15 years of age) and includes key transitions in physical environments (from elementary school to middle school and from middle school to high school) and important biological processes (such as pubertal changes). These transitions are best viewed as processes with multiple (often new) demand characteristics (eg, multiple teachers and classrooms in middle school, rather than a single teacher and classroom in elementary school) that require adaptation and control in cognitive, emotional, and social spheres. Some of the key contexts of development during this period carry forward from the past (such as caregiver relationships), although the nature of...
these relationships may be modified substantially (eg, amount of time spent together and topics of conversation). Other contexts of development are relatively new and/or assume greater significance. For instance, peers, friends, and cultural influences such as the mass media may contribute much more to the development of beliefs, personal preferences (eg, in clothes and music), behaviors, and leisure activities than they did before age 10. There is also greater involvement during this period in elective activities such as sports teams and special-interest clubs, which provide important social contexts both with adults (eg, athletic coaches and adults who lead school-related or church-related activity groups) and with peers, to foster development in cognitive, emotional, and social realms. Vital developmental tasks and issues during this period are manifold and include changes related to biological features (such as pubertal development), cognition (such as personal, ethnic, and sexual identities), and social relations (such as more-intimate, self-disclosing, peer relationships, the launching of dating and romantic relationships, and, in some instances, the early onset of sexual behavior). These developmental tasks are of great importance because they help provide the foundation for middle and later development.

In this article, we link the ways in which alcohol use may affect, and be affected by, the transitions, changes, and activities in the developmental period of 10 to 15 years of age. It is the interplay of context, relationships, and biological development that sets each individual on a unique pathway to adulthood. It is theorized that adolescents increasingly actively recruit or select their physical environments and social relationships, thereby increasing risk and/or protective factors through evolving person-environment transactional processes. Understanding what facilitates positive trajectories and outcomes and what actions (eg, interventions) can redirect negative trajectories is integral to our success in fostering healthy adolescent development.

Here we describe in more detail the developmental periods, contexts, and tasks associated with the period of ages 10 to 15, across biological, cognitive, social, and emotional levels of analyses. Levels of alcohol use during this period and the relationships between use and changes in developmental domains are discussed. We then turn to a discussion of risk and protective factors associated with alcohol use, focusing on nonspecific factors before turning to alcohol-specific risk and protective factors and concluding with the important issue of individual differences in the timing and tempo of developmental processes. Given the robust bodies of information about adolescent development and alcohol use, we conclude that it is time to think across disciplinary boundaries to identify the mechanisms and processes underlying the causes and consequences of underage drinking and to develop optimal targeted interventions.

**NORMATIVE DEVELOPMENT BETWEEN 10 AND 15 YEARS OF AGE**

**Changes in Brain and Cognitive-Affective Structures and Functions**

Changes in brain structure and function at the neural level are readily apparent in early adolescence. The period is characterized by particularly robust alterations in secondary and tertiary expanses of the cerebral cortex, encompassing components of the temporal, parietal, and prefrontal cortices, as well as alterations in key subcortical structures within the medial temporal lobe.1-5 Notably, this area includes the amygdala and hippocampus, brain structures with high densities of sex steroid receptors. As with changes in the structure of the primary cortex that occur during an earlier age period, these changes in the association cortex involve gradual decreases in gray matter volume, which presumably arise from a series of developmental processes such as reductions in synaptic connections among neurons (a process known as dendritic “pruning”). Moreover, functional connectivity seems to change during this period, consistent with the gradual increases in the white matter/gray matter ratio. These changes are likely to reflect increases in myelin (ie, the white insulating sheath that surrounds some axonal processes of neurons connecting spatially disparate brain regions), coupled with the pruning of dendritic processes in cell body (gray matter) regions.6

Such changes in connectivity are likely to contribute to maturation of neurocognitive processes that depend on functioning within distributed neural circuits. At a neural systems level, changes in structural connectivity are likely to be reflected in changes in the degree to which specific brain regions become engaged during specific cognitive tasks. It is now possible to observe such changes by using modern functional neuroimaging techniques. For example, the association cortex in the prefrontal and posterior regions has been shown to become differentially active in functional MRI studies as adolescents mature from ages 10 to 15, and key limbic regions
have been shown to exhibit parallel developmental changes.7–11 At a physiological level, changes in the physical properties of the brain and other soma reflect the influences of both hormonally related and experience-dependent processes. These physiological changes also manifest in functional aspects of the organism that are observable at the gross behavioral level. Some of the most dramatic changes are reflected in patterns of sleep and arousal regulation. The 10- to 15-year-old period involves particularly profound changes in sleep, including maturational changes in aspects of circadian regulation that contribute to adolescents' natural tendencies toward later bedtimes and later awakening times.12 Other signs of arousal regulation also show robust changes, in terms of both patterns of autonomic regulation and patterns of subjective state regulation.13 Adolescents report particularly marked extremes of emotional state fluctuation when monitored by using event-sampling methods.14

Such changes in physiological features and associated arousal patterns are associated with broader changes in behavioral regulation that may underlie risks for various psychopathological conditions. The 10- to 15-year-old period is characterized by marked increases in rates of many psychopathological conditions, including major depression, social anxiety disorder, various behavior disorders, and substance use disorders.15,16 Even among adolescents who do not meet the criteria for a specific psychopathological condition, this developmental period involves dramatic increases in high-valence emotional events and episodes of rule-violating behavior.17

Finally, the 10- to 15-year-old period involves marked alterations in cognitive processes. The salience of social stimuli typically increases, as can be seen in studies of the viewing of evocative facial photographs and the hearing of evocative vocal utterances.22 The abilities to plan, to maintain information “online,” to solve complex cognitive tasks, and to exhibit self-regulation and inhibitory control typically increase in this developmental period10 and well past age 15, into the twenties. These changes in emotional and cognitive processes are highly likely to parallel changes in underlying brain physiological features and structure.

Changes in Family, Peer, and Romantic Partner Relationships

Consistent with an ecological approach to human development, it is critical to remember that the myriad of biological, psychological, and physical changes that take place during the early adolescent period are mediated largely by the proximal social relationships in children’s lives. The most significant social relationships for all children and adolescents are those with their families and their peers, and 10 to 15 years of age is a time when these relationships undergo significant changes. Although the myth of inevitable estrangement between children and their parents during the adolescent years has been proven to be unfounded, important adjustments do occur. For instance, children spend considerably less time with their parents as the children make the transition into early adolescence. The overall frequency of parent-child conflicts does not increase during these years, perhaps because parents and children spend less time together, but the intensity of such arguments, when they do occur, seems to be greater during early adolescence.19 In addition, emotional distancing between children and their parents increases during the teenage years, particularly within the relationships between children and their fathers.19,20

Parents remain significant influences in early adolescents’ lives, but there are changes that do reflect a significant adjustment in family relationships. These adjustments are assumed to reflect the need to accommodate rapidly changing children who are no longer dependent solely on their parents and who are increasingly capable and competent. Such changes in family relationships are thought to be driven by several factors. Cognitively, early adolescents increasingly are able to think abstractly, which enables them to become better arguers and to idealize how their parents “could” be.21 Physically, the attainment of reproductive maturity has been suggested by some observers to trigger an evolutionarily adaptive mechanism to begin the process of separating from the natal family.22 Socially and emotionally, early adolescents increasingly desire autonomy and the opportunity to participate in decision-making that affects their daily lives.23

An additional factor thought to stimulate changes in family relationships is the increased exposure to and importance of peer relationships during the early adolescent period. Children spend increased time with peers during the early adolescent period. In the United States, this time with peers is largely unsupervised by adults. The transition to middle school, with the frequent changing of classes and increased time spent out of classes, results in a dramatic increase in exposure to age mates even during school hours. Peer influence increases during the years of early adolescence and is thought to peak around the ages of 11 to 13 years, precisely the time of middle school for most US adolescents.24,25 Although parents retain their significant influence on fundamental issues such as religion, morality, and education, peers are thought to have the most significant influence on issues of personal style, popular culture, and antisocial behavior. In fact, studies of developmental changes in peer influence during childhood and adolescence have observed the most consistent peaks in peer influence during early adolescence to be in the areas of risky and antisocial behaviors.24

Not all early adolescents are equally influenced by peers to engage in risky behaviors such as early alcohol use. Adolescents who have more problematic relationships with their families during early adolescence, such as those who feel that their parents either are too controlling or are not involved at all, are likely to become more focused on peers.26 Those who have the most extreme type of peer orientation, such that they are willing to sacrifice positive activities and aspects of their lives to be popular and accepted, tend to become involved in more-delinquent peer groups and to engage in more risky behaviors during the high school years.27 In addition, not all early adolescent peer groups engage in risky behaviors such as alcohol or substance use, and it is important to acknowledge the great diversity in friend-
ship cliques and peer crowds, in terms of their endorsement of alcohol use. A key developmental issue for both research and intervention is to identify the individuals who show the greatest risk for becoming involved in peer groups that encourage such risky behaviors.

The increased involvement with peers during early adolescence occurs at the same time as sexual maturation. The height of pubertal maturation occurs between the ages of 10 and 15, with girls beginning puberty 1 to 2 years before boys. With the attainment of reproductive maturity comes the emergence of secondary sex characteristics, which can be both a sign of status and a source of worry and concern as children attempt to become comfortable with their changing bodies. Adolescents vary greatly in terms of the timing of puberty, with early maturation bringing some positive effects in terms of popularity but also some negative implications, particularly among girls. Early-maturing girls have shown some signs of risk for internalization problems, perhaps because of concerns about their weight, given that a certain amount of body fat is necessary to achieve menarche. Early maturation among girls also can bring unwanted attention from older boys who engage in behaviors that are more risky for younger children, thereby exposing the girls to peer contexts in which behaviors such as drinking may be more common. Romantic and intimate relationships also begin to emerge at 10 to 15 years of age. Many adolescents in the United States begin dating around the age of 13 or 14 years, but there is variation according to gender, ethnicity, and religiosity. Dating activities during early adolescence are presumed to be more socially oriented and a way to spend time with friends. More-serious and more-enduring romantic relationships generally develop later in the adolescent years. Overall, adolescents are engaging in sexual activity more often and at an earlier age than in the past, again with important variations according to gender, ethnicity, and religiosity. Only a minority of adolescents <15 years of age have engaged in sexual intercourse. However, this minority might represent a particularly at-risk group, given that earlier sexual activity is associated with other risky behaviors, such as early drug and alcohol use. The causal direction between early sexual activity and substance use is not particularly clear, but it is an important issue to clarify when considering initiation into drinking among early adolescents and intervention targets.

Changes in Physical and Family Contexts and Societal and Cultural Influences

The period of 10 to 15 years of age is also a time of changes in the existing physical and social contexts of children’s daily lives, as well as increased exposure to newer settings. As in earlier stages of childhood, family and school are the dominant physical contexts in the lives of early adolescents. However, there are changes in the nature of these 2 contexts from earlier periods of childhood. In terms of the family, early adolescents begin a trend of gradually spending less time with their parents, which continues through the later years of high school. Time-use studies have shown that this time with parents and families is replaced by time with peers and time alone, particularly among boys. Although the home remains a dominant physical context in the lives of early adolescents, the time spent in this context gradually decreases during this period and is replaced by increased time spent outside the home in other contexts, such with peers in the neighborhood.

The shift to secondary school results in a dramatic change in the everyday school environment for early adolescents. Middle and junior high schools are much larger, more impersonal settings than elementary schools, sometimes including as many as several hundred students per grade level. Instruction becomes departmentalized according to subject matter. Children no longer spend most of the day with 1 or 2 teachers and instead change classes frequently and have several different teachers for a variety of subjects. In addition, grading becomes more stringent and based on comparative performance among different students. The increased sizes of the student body and of classes make it more difficult for teachers to engage in individual-based, creative instruction that involves high levels of student-teacher interaction. As a result of all of these changes in the learning environment, many early adolescents experience a loss of intrinsic motivation for school during the middle school years. Their grades tend to decline and their enthusiasm for and attachment to the school and academic endeavors decrease.

At the same time that early adolescents begin to spend less time at home and become less invested in school, they spend more time outside the home and in the neighborhood. Children between the ages of 10 and 15 years desire and are provided with increased behavioral autonomy by their families, which enables them to spend more time outside the home, in the neighborhood, at malls and movie theaters, and in parks and other public areas. Studies of the effects of neighborhoods on children have noted that troublesome features of some neighborhoods, including high levels of poverty, crime, and antisocial activity, can have a negative impact on children’s development, particularly during the teenage years, when children increasingly become exposed to such factors without being monitored by parents and families. The impact of deleterious neighborhood factors may be especially great in neighborhoods in which there is a dearth of high-quality after-school activities and programs that are attractive to young adolescents. In the absence of such developmentally positive, neighborhood settings, children may be increasingly exposed to older adolescents and young adults who are engaging in activities (such as alcohol and substance use) that are particularly risky for early adolescents.

With increased experience with physical settings outside the home, children become more aware of societal and normative influences between the ages of 10 and 15 years. Early adolescents become more like adults in being active consumers of cultural messages and values, largely through media and interactions with age mates. Identity issues come to the fore, as early adolescents engage increasingly in the psychosocial work of figuring out who they are and where they belong in the social landscape. They endeavor to elucidate what is expected of them behaviorally and stylistically, both by the larger
society and by their peers. Social categories and identities such as ethnicity, gender, and religion become more salient to children during this age period. Early adolescents find themselves increasingly placed in these social categories and experience differential treatment and expectations on the basis of factors such as ethnicity and gender. Experiences with prejudice and discrimination begin to increase during this period, and early adolescents find themselves pushed toward some activities and away from others on the basis of their social category membership. Early adolescents’ attempts to settle on where they belong within social groups and social categories (such as ethnicity, gender, and religion) likely include decisions about whether to begin experimenting with drinking. A key point is that children’s decision to begin using alcohol during this age period may be just as much a decision about who they are and who they want to become as it is a decision to use alcohol for its psychological and behavioral effects.

Another significant social and cultural influence on early adolescents is the media. Early adolescents spend a great deal of time with various forms of media, often out of view of their parents and thus with less opportunity for adult monitoring, communication, and/or interpretation of messages. A majority of children in this age group have television sets in their own bedrooms, and virtually all have some kind of sound system. They tend to choose more adult-oriented fare than younger children. The media industry has capitalized on the potential of this age group as a market and has developed television channels (eg, UPN and BET), radio formats, magazines (eg, Teen People and Cosmo Girl), and Web sites (eg, www.Gurl.com) aimed at attracting youths’ attention and disposable income. On average, 11- to 15-year-old youths spend 6 to 7 hours/day with some form of mass media, often using >1 form simultaneously (eg, listening to music through headphones while surfing the Internet). The Internet is an important mode of interpersonal communication for this age group; youths may spend hours each day using instant messaging to keep in touch with their friends and to meet others.

These teens see and hear alcohol-related messages in much of the media to which they attend. Alcohol is the most frequently portrayed food or drink on network television, with approximately two thirds of primetime fictional television programs depicting alcohol in ~8 drinking acts per hour. Alcohol use is portrayed in more than one fourth of videos on MTV and VH-1, both favorite television channels of this age group. Teenagers frequently are depicted drinking in teen-oriented movies and rarely are shown suffering any negative consequences.

This early adolescent developmental stage is increasingly sensitive to the values and behaviors of peers, and the mass media may serve as a kind of “super peer” for alcohol use. One study showed that earlier-sexually maturing girls were more interested in sexual content in the media than were their less-mature age mates. We should expect that teens similarly turn to media to learn about alcohol and may adopt the values and normative behaviors they see. Many studies of the effects of viewing violence on television have shown that imitative aggressive behavior is more likely if the violent acts are committed by attractive characters who do not suffer negative consequences. The same pattern holds for portrayals of alcohol in the media. Increased exposure to television, music videos, and alcohol advertising in early adolescence is associated with earlier onset of alcohol use and heavier beer drinking in later adolescence.

Because early adolescents tend to overestimate the prevalence of drug use and rarely discuss it with each other, interventions might focus effectively on shifting perceptions that “everyone is doing it.” Early adolescents also need to know the facts about negative consequences. In 1 intervention, early teens’ intentions to drink were reduced significantly after exposure to only 1 educational video about the dangers of drinking. Although this age group is increasingly skeptical of adult authority, interventions are most effective when parents are involved as sources of information and rule setters.

Older early adolescents would appreciate and respond to being asked to be part of intervention development. This is especially important in message design and channel selection if media are used, because teens’ media choices rarely appear in the commercial rating services, which tend to include all teens in a 12- to 17-year-old category. Media preferences differ dramatically according to age, gender, race, and other individual characteristics, such as need for stimulation and risk-taking. To reach this age group effectively, it is important to choose the channels used most frequently by the subgroup of most interest. Music, movies, and teen-oriented television channels are most important. The Internet may be an important channel, especially if the peer network can be exploited in some way. Adolescents in this stage of cognitive development also can be taught media literacy skills, to increase the likelihood of their perceiving the current inaccurate and incomplete portrayals of alcohol use.

Changes Associated With Puberty and Implications for Research on Alcohol Use and Abuse

In some ways we are poorly served by the concept of “puberty,” because it implies the existence of a unitary phenomenon, when in fact puberty constitutes an enormously complex set of biopsychosocial phenomena. Figure 1 provides a simplified schematic view of the ways in which puberty may have an impact on alcohol use and abuse. A significant feature displayed in Fig 1 is that puberty involves multiple CNS components and their interrelationships; puberty involves peripheral biological responses to CNS-initiated processes, the CNS responds to the activation of peripheral hormone-producing functions, and there are structural and functional neurocognitive changes, as well as peripheral morphologic changes. All of these biological phenomena occur in social (environmental) contexts that impose changing expectations for cognitive achievement and social behavior, as well as new social roles (particularly in the realm of peer relationships). Any or all of these factors may be relevant to adolescents’ use and abuse of alcohol.
It is also worth cautioning that something that occurs during adolescence is not necessarily related to puberty per se. For instance, attending high school may serve as a particular risk factor for escalating alcohol use, regardless of pubertal status. The presence of pathway 1 in Fig 1 accommodates this possibility.

In later childhood, before gonadal puberty, the output of androgens (such as dehydroepiandrosterone and androstenedione) from the adrenal glands begins to increase in both boys and girls (a process known as adrenarche; pathway 0 in Fig 1). These levels continue to increase until they peak near age 20 in women and in the early 20s in men. Although this period covers the age range for the onset of alcohol use in the vast majority of people and alcohol abuse in many, the possibility that adrenarche might be physiologically relevant to alcohol use and abuse has been understudied.

The onset of gonadal puberty is triggered by unknown brain mechanisms that seem to be under a high degree of genetic control but were shown recently to require normal leptin and kisspeptin function. The initial manifestation of puberty involves reactivation of the hypothalamic gonadotropin-releasing hormone pulse generator. Gonadotropin-releasing hormone, in turn, stimulates the release of follicle-stimulating hormone and luteinizing hormone from the pituitary gland. Presently, we do not know whether these central processes also have direct physiological implications for alcohol-related physiological processes and behavior (pathway 3). During these stages, puberty is “invisible,” because it is not until follicle-stimulating hormone and luteinizing hormone have stimulated the gonads (ovaries and testes) sufficiently to produce estrogens (principally estradiol) and testosterone that the familiar external changes of puberty (development of the breasts and external genitalia, growth spurt, and redistribution of body fat and muscle mass) occur. In other words, the onset of puberty actually occurs well before the time at which it is typically observed in the well-known Tanner stages, which are based on external observation.

There is also a great deal of variation in “end-organ sensitivity” to hormonal actions, and there are many opportunities for hormonal effects on behavior that are not well indexed with observational approaches to the measurement of pubertal status. Similar problems arise regarding menarche (the onset of menses) as a marker for the onset of puberty, because menarche is typically 1 of the later physiological occurrences of puberty. It is important to recognize that currently the average age of onset of breast and pubic hair development is typically in late childhood (~10.5 years of age for non-Hispanic white girls and 1 year earlier for non-Hispanic black girls, with intermediate ages for Hispanic girls), rather than early adolescence. The average age at menarche, however, is ~12.5 years for non-Hispanic white girls and only a few months earlier for non-Hispanic black girls.

It is commonly observed that puberty occurs ~1 to 2 years later for boys, compared with girls, and the growth spurt typically occurs relatively later within the pubertal process for boys. Generic statements about the onset of puberty in boys and girls are misleading, however, because such statements depend on what is used to indicate puberty. For instance, in a study by Sun et al.44 the median onset of pubic hair development was later for boys than for girls (12.0 vs 10.6 years for white children), but the median age of onset of genital development in boys was 10.0 years, compared with 10.4 years for the onset of breast development in girls (for non-Hispanic white children). This feature is important in the present context because, if it is true that the whole
process of puberty begins in girls a few years before it begins in boys, then we would expect any pubertal contribution to the development of alcohol use and abuse to result in the earlier onset of alcohol use and abuse among girls than among boys; however, this is contrary to the existing data. The lack of major gender differences in age at onset of adolescent alcohol use or abuse does not preclude the possibility that puberty is etiologically important for alcohol-related behavior. We also need to remember that a number of neuromaturational changes occur in the brain across adolescence, leading to substantial alterations in neurocognitive functions, some of which (such as decision-making and increased risk-taking) are associated with alcohol use. Many of these changes may be quite independent of puberty, despite occurring with it (pathway 5).

A major target organ for the sex steroids is the brain, which contains estrogen and androgen receptors in various locations. Estrogen, progesterone, and testosterone all have modulatory effects on dopaminergic pathways, as well as affecting serotonergic function.55–59 It is also important to note that some findings have suggested that hormonal influences, such as estrogen-mediated delays in dendritic pruning among girls, may affect age-related gender differences in brain maturation. Therefore, there is no shortage of possible routes by which direct physiological effects related to substance use and abuse might be instigated by gonadal maturation (pathway 4).

This is not intended to suggest that all effects of puberty must be caused by hormone actions on the brain. Two pathways in Fig 1 (pathways 2a and 2b) relate to the psychosocial effects of physical maturity. Pathway 2a indicates that physical maturity has implications for social functioning that may lead to increased risk for alcohol use and abuse. It seems likely that physically mature early adolescents are more likely to be invited to parties by older boys and thus find themselves faced with opportunities to drink. They also may find themselves in more-stressful situations, and alcohol consumption has been linked repeatedly to higher levels of environmental stress. Pathway 2b adds the additional possibility that the timing of physical maturity may have implications for the effects of maturity on behavior. This area has received the most research attention. As far as behavioral deviance (including alcohol abuse) is concerned, there is now strong evidence that girls who become physically mature earlier than their peers are at particular risk,60,61 because they may be less well endowed in terms of their cognitive development than their physical appearance would indicate (ie, there are dysynchronies in development). Therefore, they may be less able to deal appropriately with the challenges posed by the social situations in which they find themselves. The situation for boys is much less clear, but there is some evidence that early development may be linked to increased levels of alcohol consumption.60,61

A major problem with many studies of this issue is that they have typically used relatively crude markers of pubertal status (such as menarche) and not controlled for current developmental level, that is, those who began puberty earlier would be more advanced in their development at some fixed age than those who began later. A conceptual approach that acknowledges that there are several aspects of puberty and a methodologic approach that measures multiple aspects of these pubertal processes, so that effects can be attributed to particular hormonal, neurocognitive, or social aspects, are needed. Only in this way can the mechanisms responsible for associations with alcohol-related behavior be clarified. To provide maximal scientific significance, such studies would need to monitor children and adolescents across puberty, which would involve beginning longitudinal studies by age 7 or 8, to identify the key group of early matures, and monitoring the sample for ≥10 years. Only then would it be possible to clarify the effect of timing, as opposed to the level of development. Such studies would need to use endocrinological, neurocognitive, psychological, family, social, and environmental measures with samples large enough to make it possible to distinguish the effects of necessarily correlated predictors.

Levels of Alcohol Use and Consequences

Prevalence of Alcohol Use

National survey data on alcohol use are not currently collected for individuals <12 years of age. However, alcohol consumption by early adolescents is a relatively common experience. In the 2005 Monitoring the Future study,62 the proportion of eighth-graders who had used alcohol in their lifetimes was 41.0% and that of tenth-graders was 63.2%. With different time windows for use (past 12 months and past 30 days), the prevalence rates remained high. The prevalence rates for the past 12 months and past 30 days were 33.9% and 17.1% for eighth-graders and 56.7% and 33.2% for 10th-graders, respectively. Also of note for these early adolescents was the relatively high level of use of flavored alcoholic beverages (eg, alcopops). Among eighth-graders, 35.5% reported using flavored alcoholic beverages in their lifetime; the prevalence was 57.0% among 10th-graders. Although these data do not provide information regarding how frequently flavored alcoholic beverages are consumed, relative to how frequently nonflavored alcoholic beverages are consumed, they do indicate that flavored alcoholic beverages are used by a large number of early adolescents.

In addition to the prevalence of alcohol use, the Monitoring the Future data indicated that 19.5% of eighth-graders and 42.1% of 10th-graders reported having been drunk in their lifetimes and 10.5% of eighth-graders and 21.0% of 10th-graders reported having consumed ≥5 drinks on a single occasion in the past 2 weeks. These data, considered in conjunction with the data on the prevalence of use, suggest an episodic or opportunistic pattern of drinking among early adolescents. That is, a large majority of early adolescents who drink do not drink daily but, when they do drink, they often drink to excess. As is evident elsewhere in this article, such high levels of drinking on single occasions or drinking until drunk may have multiple adverse effects on optimal health and development, by negatively influencing biological, cognitive, and social systems and functions.

Attitudes and beliefs about alcohol use among ado-
lescents are also of importance in identifying potential targets for intervention studies. Data from the 2005 Monitoring the Future study indicated that 64.2% of eighth-graders and 83.7% of 10th-graders rated the accessibility of alcohol as fairly easy or very easy. With regard to perceived harm resulting from alcohol use, 57.2% of eighth-graders and 53.3% of 10th-graders rated ≥5 drinks of alcohol once or twice each weekend as a “great risk.” However, less than one third (31.4%) of eighth-graders and 31.2% of 10th-graders rated 1 or 2 drinks nearly every day as a “great risk” for harm. Strong disapproval of alcohol use was relatively high, with 51.2% of eighth-graders and 38.5% of 10th-graders indicating disapproval or strong disapproval of people who try 1 or 2 drinks. However, the large grade-level differences between eighth- and 10th-graders regarding strong disapproval suggest that attitudes and perceptions change across this early adolescent period, toward less disapproval of using alcohol.

Biological, Cognitive, Affective, and Social Processes That Influence Interactions Between Development and Underage Drinking

Studies examining the biological sensitivity of adolescents to alcohol are limited because of ethical issues regarding administration of alcohol to human youths for research purposes. However, research using animal models of adolescence has revealed that adolescents are considerably less sensitive than adults to most consequences of ethanol. These effects are seen even when controlling for blood alcohol levels and the slightly faster rate of ethanol metabolism that is sometimes seen during adolescence. Alcohol effects to which adolescents are relatively insensitive include many that serve as cues to limit intake, including ethanol-induced motor impairment, dysphoria, social impairment, and sedation, as well as certain postintoxication, “hangover” effects. Although studies distinguishing age effects within adolescence are limited, the available data suggest that these adolescent-related insensitivities to ethanol may be particularly pronounced during early adolescence.

A similar adolescent insensitivity to ethanol may be seen in human adolescents. Although comparable human data are almost nonexistent, a study conducted several decades ago challenged 8- to 15-year-old boys with 0.5 mL/kg pure ethanol, a dose inducing peak blood alcohol levels of ~34 to 35 mg per 100 mg. Blood alcohol levels well within the intoxicating range in adults. However, Behar et al. found no behavioral signs of intoxication in those youths and noted that they “were impressed by how little gross behavioral change occurred in the children after a dose of alcohol which had been intoxicating in an adult population.” Attenuated sensitivity during adolescence to negative consequences of ethanol that normally serve as cues to limit intake may permit relatively high levels of drinking, contributing to the greater per-occasion consumption levels seen in human adolescents, relative to adults (eg, 4.9 drinks per consumption day among 12-20-year-old youths, compared with 4.2 drinks per consumption day among 21-25-year-old adults and 2.6 drinks per consumption day among ≥26-year-old adults), and the two- to threefold higher ethanol intakes (in grams per kilogram) seen under some circumstances in adolescent rats, relative to adults. A similar insensitivity to alcohol is evident in individuals with a family history of alcoholism and may combine with the ontogenetic insensitivity to ethanol normally seen during adolescence to precipitate unusually high intakes of ethanol when genetically at-risk adolescents begin to drink.

In contrast to the relative insensitivity of adolescents to most effects of ethanol, they are more sensitive than adults to a few effects of ethanol, including the social facilitation seen at low doses of ethanol; this ethanol-induced social facilitation may serve to encourage ethanol consumption, given the unusual sensitivity of adolescents to stimulation of ethanol intake by social experiences in humans and laboratory animals. Animal studies have also shown adolescents to be more sensitive than adults to ethanol-related impairments in brain plasticity (ie, long-term potentiation) and memory, with the latter effect being reported for human adolescents as well. This combination of ethanol sensitivities seems inopportune for adolescents, with attenuated sensitivities to cues that normally serve to moderate drinking likely encouraging relatively large ethanol intakes but those elevated intakes exacerbating the already increased sensitivity of adolescents to ethanol-induced disruptions of hippocampal function and spatial memory.

Consequences of Normative Drinking

Adverse social and health consequences occurring in conjunction with alcohol use, and especially heavy use, are quite prevalent among adolescents, although many studies include a broader age range than 10 to 15 years of age when considering such consequences. Windle and Windle reported on adverse alcohol-related consequences for a community sample of adolescents (mean age: 16.96 years). Among those who had consumed alcohol in the past 6 months, almost 75% reported ≥1 alcohol-related problem. The prevalence rates for a few specific problems were as follows: passed out from drinking, 29.6%; did things while I was drinking that I regretted the next day, 47.7%; had a fight with members of my family about my drinking, 16.2%; got into a fight or heated discussion with someone I didn’t know when I was drinking, 16.6%. Across 15 possible alcohol-related problems, 44.1% of respondents reported ≥3 problems in the past 6 months.

Alcohol use among early adolescents has also been associated with a range of suicidal behaviors, including ideation, attempts, and completions. Windle et al. used data from the National Adolescent Student Health Survey to investigate the prevalence of lifetime suicidal ideation and suicide attempts among male and female adolescents characterized as abstainers (ie, did not drink in the past 30 days), light drinkers (ie, drank on 1–5 occasions in the past 30 days), or moderate/heavy drinkers (ie, drank on ≥6 occasions in the past 30 days). For both male and female adolescents and eighth- and 10th-graders, a linear relationship was found between level of alcohol use and suicidal ideation and attempts. For example, among 10th-grade female abstainers, 33.5% had
thought about committing suicide and 12.3% had attempted suicide. Among light drinkers, 52.0% had thought about committing suicide and 21.4% had made an attempt. Finally, 63.1% of heavy drinkers had thought about committing suicide and 38.8% had attempted suicide.

Findings have indicated that alcohol consumption among early adolescents increases the probabilities that they will engage in sexual intercourse and also that they will engage in risky sex (eg, having multiple sexual partners). Data from the Youth Risk Behavior Surveillance study indicated that, among sexually active teens, 26.2% of ninth-graders and 21.1% of 10th-graders reported alcohol or drug use at most-recent sexual intercourse. Using data collected from the 1999 Harvard College Alcohol Study, Hingson et al evaluated the associations between an earlier age of onset of first intoxication and college students’ reports that drinking caused unplanned sex and unprotected sex. The findings indicated that students who reported a younger age of intoxication, relative to those who reported a later age of intoxication or never having been intoxicated, were more likely to report that drinking caused unplanned sex and unprotected sex. For example, 31.2% of students who were ≤12 years of age at first intoxication reported that alcohol “caused” them to engage in unplanned sex; in contrast, <5% of those who reported never having been intoxicated thought that alcohol caused them to engage in unplanned sex.

Developmentally Related Effects of Alcohol Use and Exposure
When potential long-term consequences of adolescent alcohol use are being considered, an important consideration is whether this exposure increases the probability of later ethanol use and development of alcohol use disorders. In both prospective and retrospective human studies, early onset of alcohol use typically emerges as a reliable predictor of later problematic use of and dependence on alcohol and other drugs. For instance, in survey data, the rate of lifetime alcohol dependence was found to be 40% when individuals started drinking at ≤14 years of age but was only 10% when drinking was not initiated until ≥21 years of age. It remains unclear, however, whether early use of alcohol is causal or merely serves as a marker of later problematic alcohol use. For instance, evidence is accumulating that externalizing problems seen early in childhood serve as developmental precursors of alcohol use disorders and also increase the probability of early drinking onset, with this early onset thus serving as an intermediate marker for later alcohol use disorders. It is also possible that early exposure to alcohol alters developmental processes during adolescence, with long-term effects on neurobehavioral functions that increase the propensity for later abuse. Indeed, there is evidence that chronic heavy alcohol use during adolescence is associated with cognitive deficits and alterations in brain activity and morphologic features. Some of these neurocognitive deficits may predate use and serve as risk factors for early and substantial adolescent alcohol use, whereas others may be a result of this consumption; these possibilities require additional investigation in longitudinal studies.

Studies using animal models have begun to explore whether there is a causal relationship between early exposure and later alcohol consumption and whether exposure to alcohol during adolescence has lasting neurobehavioral consequences. Although findings are mixed, voluntary drinking of alcohol during adolescence has been reported to facilitate acquisition of alcohol self-administration in adulthood, to increase “craving” behavior and probability of relapse, and to exacerbate stressor-specific increases in alcohol intake. Chronic exposure to alcohol during adolescence also has been reported to induce long-lasting tolerance that serves to “stamp in” the adolescent-associated insensitivity to the sedative and motor-impairing effects of ethanol, so that these insensitivities persist into adulthood, perhaps contributing to greater propensities for high levels of alcohol use in adulthood. Such chronic exposure in adolescence also might stamp in vulnerability to ethanol-induced memory impairments, resulting in maintenance of these adolescent-typical vulnerabilities in adulthood. Adolescents seemed to be notably more vulnerable than adults to brain damage induced by using a binge model of alcohol exposure in rats, with greater adolescent damage seen in a variety of regions, including the frontal cortex. Although these studies have revealed that adolescent alcohol exposure can have lasting effects on neural and behavioral function, the comparability of these exposures to those seen in human adolescents remains to be determined.

Animal research has shown additional effects of adolescent alcohol consumption. Ethanol-related alterations in hormone levels differ during adolescence, compared with adulthood. For example, acute exposure to ethanol increases testosterone levels during adolescence, compared with adulthood. For example, acute exposure to ethanol increases testosterone levels in male rats early in adolescence, while having no effect on testosterone levels in rats mid-adolescence and suppressing testosterone levels in postadolescent and adult rats. Chronic exposure to ethanol during early adolescence has been shown to alter puberty-associated hormone levels and pubertal timing. In female rats, chronic exposure to ethanol early in adolescence alters serum concentrations of hormones associated with puberty, such as luteinizing hormone, and delays puberty. In contrast, chronic exposure to alcohol beginning before and continuing through adolescence has been reported to increase aggressive behavior and testosterone levels in male hamsters and to advance the onset of sexual behavior in male rats, although delays in puberty-related increases in testosterone levels and sex organ size after adolescent alcohol exposure in male rats have also been reported.

NONSPECIFIC RISK AND PROTECTIVE FACTORS
Identification of Factors
Given the widespread use of alcohol during adolescence, an array of important research questions have focused on what factors increase risk for the more-troubling aspects of adolescent alcohol involvement, including early onset of use, escalation to frequent high-level
drinking, emergence of alcohol-associated problems (eg, poor school performance, conflicts with parents, violence, and driving under the influence), and manifestations of alcohol dependency symptoms. A broad range of risk factors that do increase the risk for alcohol use behaviors among children and adolescents have been identified.\textsuperscript{101,102} No single factor has emerged as omnipotent in the prediction of adolescent alcohol-related behaviors. Rather, constellations of factors tend to cooccur in the prediction of problematic outcomes. Research has also focused on the identification of factors that mitigate or eliminate risk for the expression of problematic alcohol use behaviors; such factors are referred to as protective factors.\textsuperscript{103} It should be noted that there are a number of risk and protective factors (ie, protective factors reduce probable adverse outcomes) that have been identified for older adolescents and adults (eg, a polymorphism at the \textit{ALDH2} locus); however, this section focuses on findings for early adolescents.

Risk factors for alcohol use, abuse, and use disorders across the course of adolescence have been reviewed elsewhere,\textsuperscript{101,102} and 2 general conclusions can be drawn. First, risk factors occur at multiple levels of influence, ranging from biogenetic factors to individual (psychological), family, and peer factors and to neighborhood, community, and cultural factors. Second, alcohol use and alcohol problems during childhood and adolescence are typically predicted by multiple risk factors, although different risk factors may emerge as predictive of adverse outcomes at different ages during adolescence. Some risk factors seem to operate in a dynamic way across time. For example, person-environment and gene-environment models of the causes of adolescent alcohol use and problems describe characteristics of individuals that shape subsequent development and subsequent exposure to risk. Provided below are some of the major nonspecific risk factors and a brief characterization of how they may pose risks. By nonspecific, we refer to findings that suggest that these factors may influence other psychopathological conditions (eg, affective and anxiety disorders) in addition to alcohol use, problem drinking, and alcohol disorders. More alcohol-specific risk factors are considered in a later section.

**Risk Factors**

**Temperamental and Personality**

Temperamental attributes have been defined in numerous ways, but there is a general consensus that such attributes are of early onset (eg, at birth or during infancy), are genetically influenced, and are relatively stable aspects of behavior that are involved in emotional reactivity and the regulation of behavior. Numerous studies have indicated significant associations between temperament and alcohol use among early and middle adolescents. For example, Tubman and Windle\textsuperscript{104} reported that, both concurrently and prospectively (over a 1-year period), a more difficult temperament (defined as higher activity level, lower task orientation, inflexibility, withdrawal orientation, biological arrhythmicity, and low positive mood) predicted higher levels of alcohol problems among middle adolescents. In addition to research demonstrating significant associations between temperamental dimensions and adolescent alcohol use, several studies of personality dispositions and adolescent alcohol use have supported significant associations. For example, there have been consistently positive associations between sensation-seeking and higher levels of adolescent alcohol use. Cloninger et al\textsuperscript{105} reported that childhood (11 years of age) personality characteristics of high novelty-seeking, high reward dependence, and low harm avoidance predicted subsequent alcohol abuse. Other studies reported statistically significant correlations between aggression and features of behavioral undercontrol (eg, delinquent activity, impulsivity, and difficulty inhibiting responses) and more serious levels of adolescent alcohol use. The available evidence on temperament and personality associations with adolescent alcohol use suggests strongly that some of these attributes are influential in the expression of adolescent alcohol-related behaviors. Furthermore, many of the attributes seem to share a core commonality associated with low inhibitory control and behavioral dysregulation.

Researchers have begun to explore distinctions among different personality bases for impulsive behaviors such as alcohol use. There is evidence in young adult samples that negative urgency (the tendency to act rashly in response to subjective distress) and positive urgency (the tendency to act rashly when experiencing unusually positive moods) tend to explain problem levels of alcohol involvement.\textsuperscript{106–110} In contrast, sensation-seeking may tend to explain drinking quantity and frequency but not drinking problems, once mood-based impulsivity is taken into account.\textsuperscript{109} Given that other aspects of biopsychosocial development occur in early adolescence, the possibility of mood-based impulsivity being important during this age period merits additional investigation.

**Childhood Behavior Problems**

Several long-term, prospective studies have supported an association between externalizing childhood behavior problems (physical aggression, violence, and symptoms of conduct disorders) and the subsequent development of early-onset alcohol problems and expression of alcohol disorders in adulthood. Moreover, shorter-term prospective studies yielded significant associations between childhood undersocialized aggression and hyperactivity and higher levels of alcohol use among adolescents. In a prospective study of 755 boys 6 years of age, Dobkin et al\textsuperscript{111} reported that disruptive behaviors (eg, fighting, hyperactivity, and oppositional behaviors) measured at 6 years of age significantly predicted having been drunk and/or using other drugs before 14 years of age. Similarly, in a separate prospective study of children, Johnson et al\textsuperscript{112} reported that earlier, unsanctioned (ie, without parental permission), alcohol use was associated with more conduct problem behaviors by 10 to 12 years of age and accelerated growth of those conduct problems across the transition from late childhood to early adolescence. With a sample of 166 adolescents (99 boys and 67 girls) in treatment for alcohol and drug abuse, Brown et al\textsuperscript{113} reported that 47\% met \textit{Diagnostic
and Statistical Manual of Mental Disorders, Revised Third Edition, criteria for conduct disorder. The occurrence of conduct disorder among this sample of treated adolescents was related to a poorer clinical course in a 2-year, posttreatment, follow-up study. Treated adolescents with a clinical diagnosis of conduct disorder, compared with treated adolescents without conduct disorder, were involved in higher levels of alcohol use (eg, more drinking days per month), had more alcohol problems, and had more alcohol withdrawal symptoms during the 2-year follow-up period.

Among children 10 to 15 years of age, the literature suggests strongly that the expression of multiple problem behaviors predicts subsequent substance abuse disorders and comorbid psychiatric disorders. In addition, there are high rates of comorbid mental health disorders among adolescents in treatment for substance abuse disorders. To date, childhood disorders other than disruptive behavior disorders, such as anxiety and depressive disorders, have not been studied as extensively in relation to early adolescent alcohol-related behaviors, although the adult literature clearly indicates substantial rates of comorbidity involving anxiety and depressive disorders among adults with alcoholism.

**Family Factors**

Family influences have been associated with levels of adolescent alcohol use and other problem behaviors. For example, higher levels of marital conflict and marital dissatisfaction have been associated with more adolescent alcohol use. Similarly, higher levels of family stressful events and violence within the family have been associated with earlier onset and more-involved pattern of alcohol use by adolescents.

**Protective Factors**

**Temperament**

Although some studies have supported difficult temperament as a risk factor for the development of adverse, alcohol-related behaviors, Werner and Smith reported prospective data regarding how temperament may function as a protective factor for high-risk groups. In their influential, longitudinal, Kauai study of low-socioeconomic status children of alcohol-abusing parents, Werner and Smith reported that a cuddly, affectionate, temperamental style in infancy and early childhood was associated with decreased risk for alcohol-related and other adverse outcomes for offspring in adolescence and adulthood. The explanation offered for these findings was that such children elicited more-frequent, stronger, social and emotional support from their environmental contexts. This support, in turn, contributed to the development of age-appropriate social and cognitive skills, which facilitated normative development and were perpetuated across the life course. The concept of goodness of fit accommodates these seemingly contradictory findings regarding temperament as a risk or protective factor by viewing temperamental attributes as relational (ie, influenced by and influencing their physical and social contexts). Individual variations in temperament may contribute to negative or positive behavior interaction cycles that are perpetuated across time and settings, contingent on the individual characteristics and contextual demands and opportunities involved.

**Religiosity**

Level of religiosity has often been identified as a protective factor for the early onset of and progression toward serious involvement with alcohol among adolescents. A weak negative correlation between level of religious commitment and alcohol use was the prototypical empirical finding, although there was some variability in the strength of the association depending on the manner in which religiosity was measured (eg, affiliation or frequency of attendance) and what other variables were included in prediction equations. For example, after including the variables of parental monitoring and family drug use, Bahr et al reported that religious importance was not significantly associated with peer drug use or current adolescent substance use. Therefore, level of religiosity, by itself, may not be a consistent potent predictor of adolescent alcohol use. However, level of religiosity may be better conceptualized as a marker or an indirect factor (influenced by and influencing family relationships and community ties), rather than a direct factor.

**Parenting Factors**

Parenting factors have been prominent correlates and predictors of adolescent alcohol use. The source of these family influences (ie, genetic and/or environmental) is still subject to debate, but the emerging consensus is that both genetic and environmental sources are important and the relative influences may vary, depending on the phenotype studied (eg, severe alcohol dependence versus ever tried alcohol) and the age period under investigation. The following discussion focuses on presumed socialization influences, rather than direct genetic contributions.

With regard to parenting practices, 4 domains have been identified as significantly associated with adolescent alcohol use. Parental nurturance, or level of emotional warmth and support, has been consistently related inversely to level of adolescent alcohol use. Parents who are viewed by their adolescents as more caring, concerned, and supportive of them have offspring who initiate alcohol use later and consume lower levels of alcohol. Higher levels of parental monitoring, or establishing and enforcing reasonable rules for adolescent conduct, also have been related inversely to adolescent alcohol use. That is, the adolescents of parents who establish explicit rules and boundary conditions for permissible adolescent behaviors (eg, curfew, hours of study per day), with reasonable, consistently enforced contingencies for rule violations, tend to initiate alcohol use later and to consume alcohol less frequently. Greater amounts of time spent together by adolescents and their parents have been associated with lower levels of adolescent alcohol use, as have higher levels of parent-adolescent communication. Although these parenting behaviors may be distinguished conceptually and method-
ologically, at a higher level they all may reflect common processes related to the level of parental involvement or parents’ investment in their adolescent offspring, with greater parental involvement being associated with greater internalization by the adolescents of parental norms for drinking and other behaviors.

**ALCOHOL-SPECIFIC RISK AND PROTECTIVE FACTORS**

In addition to the nonspecific risk and protective factors discussed above, a number of alcohol-specific risk and protective factors have been identified. A positive family history of alcoholism has been associated with four- to ninefold increased risk of alcoholism for male offspring and two- to threefold increased risk for female offspring. That is, sons of alcoholic men are 4 to 9 times and daughters are 2 to 3 times as likely to express an alcohol disorder as are the sons and daughters of men who are not alcoholic. These general findings have been supported through adoptee and twin research designs and are consistent with family resemblance studies in supporting a genetic intergenerational association for the inheritance of alcohol disorders. With specific reference to early adolescence, a family history of alcoholism has been associated with higher levels of alcohol use and deviant behaviors and with an earlier age of initiation of alcohol use.

Peer factors are perhaps the most frequently cited proximal influence on adolescent alcohol use. In many prediction studies of peer influences on adolescent alcohol use, the number of alcohol-using friends (or the proportion of alcohol-using friends) was the most potent predictor of adolescent alcohol use, sometimes accounting for as much as 50% of the variance. The empirical literature has consistently supported the importance of peers in accounting for adolescent alcohol use, and such peer influences seem to operate through both initial selection processes and subsequent reciprocal socialization processes. Therefore, peer selection is not a random process but involves sophisticated social interaction patterns of selection, deselection, and dropout of 1 peer group and affiliation with new peer groups on the basis of common interests and activities, whether such interests are in the direction of musical interests or scholastic events or deviant activities, including alcohol use. As escalatory cycles into heavier alcohol use or drug use are initiated, some members drop out of peer groups, whereas others increase the peer bond and group affiliation associated with given activities.

Among the family factors associated with levels of adolescent alcohol use is the use of alcohol within the family. In families with an alcoholic parent, there are a range of familial and parenting processes that contribute to heightened inconsistency in parenting practices, greater spousal and child abuse, greater spousal conflict, and more stressful events (eg, financial strain associated with sporadic employment for the alcoholic parent), which may undermine a relatively stable, emotionally supportive context for child and adolescent development. This instability may contribute to earlier and more-severe patterns of alcohol involvement for adolescents who seek to escape the unpleasantness of the home environment as they move toward a more-deviant peer context for social and emotional support.

In addition to parental influences on adolescent drinking, older siblings have been identified as role models and influential agents who contribute to higher rates of adolescent alcohol use. With an adolescent sample ranging in age from 11 to 17 years, Ary et al reported a concurrent (ie, cross-sectional) regression coefficient of 0.44 (P < .001) between older sibling alcohol use and younger adolescent alcohol use. On the basis of a sample of 508 families with a focal adolescent 11 to 13 years of age and an older sibling 14 to 18 years of age, the findings of Needle et al indicated statistically significant associations between older sibling and younger sibling alcohol use. Specifically, if the older siblings were nonusers of alcohol in the past year, then >90% of the focal adolescents reported nonuse in the past year. If the older siblings reported using alcohol ≥20 times in the past year, then >25% of the focal adolescents reported usage.

Alcohol expectancies have been associated consistently with earlier onset of alcohol use, higher levels of alcohol use (eg, frequency and quantity), and prospective transitions to increased levels of alcohol use. Alcohol expectancies have emerged from social learning theory formulations and are important to understand because they may reflect subjective utilities (eg, costs and benefits) associated with alcohol use (a more-thorough description of expectancies is provided below). Much of the initial research on alcohol expectancies was conducted with adults, but there have been increasing numbers of studies with children and adolescents. In a prospective study, Christiansen et al reported that alcohol expectancies held by nondrinking seventh- and eighth-graders (ie, those who had consumed ≤4 drinks in their lifetime) predicted >25% of the variance in levels of alcohol use 12 months later. In addition, 5 of the 7 alcohol expectancy scale scores assessed at the first occasion of measurement differed significantly between adolescents who became problem drinkers at the second occasion of measurement (1-year interval) and adolescents who were not problem drinkers at the second occasion. Several other prospective studies supported the utility of adolescent alcohol expectancies as short- and long-term predictors of alcohol-related behaviors, and some indicated bidirectional relationships between alcohol use and alcohol expectancies (ie, across-time alcohol expectancies predicted increases in alcohol use, and alcohol use predicted increases in alcohol expectancies). The findings of Stacy et al indicated that adolescent expectancies predicted substance use 9 years later, controlling statistically for initial level of adolescent substance use.

The application of expectancy theory to the problem of maladaptive drinking is a good example of the application of basic science findings to human problems. The basic science literature has produced the following perspective on expectancies. The human brain is always preparing for action by anticipating future events and generating tentative response plans. As part of this process, humans routinely form stimulus-stimulus expectations, which are expectations of which stimuli go
together in the environment; doing so helps humans perceive order and predictability in their worlds. Humans also routinely form response-outcome expectancies, which are expectations concerning the likely consequences of behavioral options.121-123 Stimulus-stimulus and response-outcome expectancies are influenced by experience123 and by individual differences in responsiveness.124 Alcohol use behavior and its range from nonproblem use to problem use can (like any behavior) be explored profitably with these tools.125

Alcohol expectancies seemed to form first as stimulus-stimulus expectancies. Children 3 to 5 years of age tended to guess that adults consuming a beverage in a picture were consuming alcohol, and individual differences in that tendency predicted drinking levels 9 years later.126 Therefore, the association of adults (who are generally important, powerful, role models) with alcohol consumption proved important in understanding future behavior. By 9 or 10 years of age, children seemed to form response-outcome expectancies for drinking.127-131 Their response-outcome expectancies at that age tended to be negative; third-graders tended to associate drinking with acting wild, dangerous, rude, or goofy.128 Even at those young ages, however, children who endorsed more-positive expectancies tended to drink more.128

Studies of slightly older children indicated that such children tended to endorse more-positive expectancies and their endorsement of positive expectancies mirrored greater alcohol consumption.127,128,130,131 Unfortunately, we do not yet have longitudinal data mapping the progression of expectancy endorsement and its prediction of subsequent drinking among children 10 to 12 years of age. This gap in the literature is an important one that needs to be rectified. The period from age 10 to age 12 involves, for most children, the transition to middle school and, in many ways, adolescence. Because of individual differences and contextual factors, this transition may become a turning point for some children, and their developmental trajectories may become characterized by maladaptive features.132

Several findings suggest the likelihood that individual differences in childhood expectancies would predict differences in drinking behavior during these early adolescent years. First, Goldberg et al133 found that perceived benefits of drinking (ie, positive response-outcome expectancies) predicted drinking behavior over 6 months among fifth-graders. Second, there is a high degree of convergence in endorsement of child-based and adolescent-based expectancy measures by children on the cusp of adolescence.131 This finding is important because adolescent measures of alcohol expectancies assessed during the first year of middle school predict future drinking behavior.130,134

Among nondrinking youths in seventh grade (the first year of middle school), the expectancy that alcohol facilitates social experience predicted both drinking behavior and problem drinking behavior 1 year later.134,135 Individual differences in the expectancy for social facilitation from drinking predicted different drinking trajectories over 2 years.136 Grube and Agostinelli136 also found that expectancies predicted subsequent drinking, whereas Colder et al137 found that expectancies predicted drinking onset but not growth in heavy drinking. However, the studies by Grube and Agostinelli136 and Colder et al137 both used samples that combined younger and older adolescents, who are at different developmental stages and face different developmental transitions.

Given that alcohol expectancies successfully predict later alcohol drinking during this age period, it is important to understand the multiple interactive factors that influence their formation. As anticipated, learning experiences influence expectancy formation. Family history of alcoholism, parents’ drinking levels, perceptions of peer drinking, and prototypes of typical adolescent drinkers all seem to help shape expectancies.135,138 In addition, previous drinking experience influences subsequent expectancies.138 Adolescents who begin drinking early tend to increase their subsequent endorsement of positive alcohol expectancies, in a positive feedback loop.134 Expectancies in late childhood may be pliable; 2 studies modified alcohol expectancies in preadolescent children through focused interventions.130,139 It also seems that individuals may be differentially prepared to form high-risk expectancies, as a function of personality factors.140 Smith et al124 demonstrated that individuals with different personalities formed different expectancies from the exact same experience, and late adolescent cross-sectional data on alcohol expectancies are consistent with this possibility.141-143

Learning and personality factors likely interact with aspects of the developmental transition to adolescence and middle school to influence expectancy formation. The developmental literature is rich with models for understanding the risk process during developmental transition-linked turning points,132 such as the joint occurrence of puberty and school transitions, exposure to multiple stressors simultaneously, heightened biological or psychological sensitivity to transitions, and other factors that influence risk. Whether these factors influence expectancy formation, and how they do so, still needs to be studied and should be addressed with longitudinal research designs.

INDIVIDUAL DIFFERENCES IN TIMING AND TEMPO OF ADOLESCENT DEVELOPMENT

In early adolescence, numerous changes in structure and function occur across biological, cognitive, emotional, and social systems. As has been demonstrated, changes within these various systems (eg, pubertal development) are multiple and vary considerably among individuals, necessitating a greater appreciation of the complexity involved in using the general term “adolescence.” Despite considerable individual variation among early adolescents in developmental trajectories, it is still useful to describe and to differentiate normative and nonnormative development. Normative development involves the notion that there are broad age periods during which various developmental processes occur (eg, physical growth spurt), with variability occurring within the statistically normative range being unlikely to result in major delays in development or to affect future outcomes severely. In a number of instances, however, the occurrence of off-time transitions that are statistically
nonnormative, relative to peers of the same age and gender, can contribute to nonnormative trajectories. A source of such nonnormative development is the dysynchronies associated with, for example, earlier onset of puberty in girls, which poses a risk associated with a mismatch between maturational changes in physical sexual characteristics in girls and the lack of corresponding maturity in cognitive and social skills systems. Such early-maturing young girls may become targets of older boys, with attendant opportunities/risks to use alcohol and other substances and to engage in sexual activities. Such physical maturity in these early matures does not necessarily imply that cognitive development and emotional development are at parallel levels or that social skills have been developed to identify risky situations or to process potential consequences of ill-advised behaviors. It is highly probable that future research, using more-advanced methods and technologies (eg, neuroimaging), will identify other developmental dysynchronies, which may have implications for a range of early adolescent behaviors (eg, CNS changes and self-regulatory capacities) and for the impact and consequences of alcohol use during this period of the life span.

CONCLUSIONS
Pervasive drinking by youths in the United States (and in many other countries around the world) and the highly prevalent emergence of problem drinking and dependence in late adolescence are inextricably connected to developmental processes. Therefore, a developmental perspective is essential for fully elucidating the scientific basis of these phenomena and for successfully preventing and treating the causes, problems, and consequences associated with excessive alcohol consumption. Because each individual human is a living system and exists within multiple external social and cultural systems, behavior and behavior problems emerge from a complex interplay among these systems. To capture this interplay fully, multiple scientific disciplines and multiple levels of analysis must be integrated successfully. It also must be understood that each human is an active agent in determining developmental pathways and that resilience (resistance to moving down problematic pathways) is as important to understand as are processes leading to maladaptation and disease.

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Transitions Into Underage and Problem Drinking: Developmental Processes and Mechanisms Between 10 and 15 Years of Age

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