The Epidemiology and Etiology of Adolescent Substance Use in Developmental Perspective

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It is no surprise that substance use typically begins and escalates during adolescence. If there were a time in the life span that was "built" for substance use onset and escalation, it would certainly be adolescence. Individual and contextual changes are more pervasive and rapid during adolescence than during any other time of life. Infants experience more rapid physical and cognitive changes than do adolescents, but whereas infants are blissfully unaware of the rapid changes, adolescents are often acutely aware of the changes happening in their bodies, minds, and social worlds. Amidst these ubiquitous developmental changes, it is no coincidence that interest in and opportunity for alcohol and other drug use begins for most young people (Masten, Faden, Zucker, & Spear, 2008; Schulenberg, Maggs, & Hurrelmann, 1997). Although alcohol and drug use are not without significant risks, experimentation can also serve numerous perceived positive functions during adolescence. It can provide a quick way to cope and blow off steam, indicate autonomy from parents, facilitate shared experiences and social integration with peers, and represent exploration of new sensations, experiences, and tastes of some perceived fruits of adulthood (Crosnoe, 2011; Maggs, Almeida, & Galambos, 1995). Indeed, as Baumrind (1987) concluded when considering the overwhelming array of substance use correlates, it is instructive to ponder why some adolescents refrain from initiating alcohol and other drug use.

Our purpose in this chapter is to provide a selective summary and integration of conceptualizations and empirical results regarding the epidemiology and etiology of substance use during adolescence from a developmental perspective. As illustrated by our own work, we believe that epidemiology and etiology can and should go hand in hand, together offering a more comprehensive and holistic picture of the development of adolescent substance use. There have been several recent excellent literature reviews and integrations of the multiple risk factors and developmental mechanisms of adolescent alcohol and other drug use (e.g., Brown et al., 2008, 2009; Chassin, Hussong, & Beltran, 2009; Dodge et al., 2009; Windle et al., 2008; Zucker, Donovan, Masten, Mattson, & Moss, 2008). We build on

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these reviews by offering integrative overviews of concepts and illustrative findings. We first frame the issues by summarizing the prevalence of use of various substances during adolescence, offering a needed historical perspective. We then consider key developmental concepts as they relate to the understanding of substance use during adolescence. Next we summarize the wide range of risk and protective factors for substance use. We conclude with implications for future research.

Adolescent Substance Use: Reasons to Worry

Substance use during adolescence is associated with numerous acute and long-term health and social effects (National Institute on Drug Abuse, 2012) and countless personal and family tragedies. Alcohol-related fatalities are responsible for the deaths of about 5,000 adolescents under the age of 21 each year due to preventable events including motor vehicle crashes, homicides, suicides, and other accidents and injuries (Hingson & Kenkel, 2004). Substance use during adolescence is also a predictor of substance-related problems and other negative health and social consequences in adulthood (Grant et al., 2004; Gunzerath, Faden, Zakhari, & Warren, 2004; Schulenberg, Maggs, & O'Malley, 2003).

The NIDA-funded Monitoring the Future (MTF) study has been collecting US nationally representative data annually from 12th graders since 1975 and from 8th and 10th graders since 1991 (Johnston, O'Malley, Bachman, & Schulenberg, 2012) and is a primary source of historical and developmental trends in substance use among American adolescents. Important strengths of epidemiological studies such as MTF include their careful attention to the representativeness of samples and consistency of methods over time, providing the basis for accurate characterization of a given problem. They can provide needed information of the broader cultural context, the macrosystem and chronosystem in Bronfenbrenner's human ecology framework (1979), in which the developing adolescent is embedded. We summarize national rates and trends of substance use, giving attention to sociodemographic variation.

Prevalence

Based on the 2011 MTF data from 8th, 10th, and 12th graders, 16 %, 35 %, and 46 %, respectively, reported using marijuana at least once in their lifetime. Corresponding rates for lifetime use of an illicit drug other than marijuana were 10 %, 16 %, and 25 %, respectively. As expected, rates of alcohol use were higher than rates of illicit drug use: Rates of lifetime alcohol use were 33 %, 56 %, and 70 % across the three grades, respectively, and corresponding rates of lifetime drunkenness were 15 %, 36 %, and 51 %. Rates of lifetime cigarette use were 18 %, 30 %, and 40 %, respectively, across the three grades. Two apparent facts are worth highlighting: (1) There is a clear developmental gradient to substance use onset across adolescence and (2) especially among 8th and 10th graders, the large majority of current US youth typically avoid substance use, and even by 12th grade, most have not tried cigarettes or an illicit drug other than marijuana (Johnston et al., 2012). That is, drug use onset increases across adolescence, but even by 12th grade, most adolescents are now avoiding cigarette and illicit drug use (a comment that does not apply to all of the recent past, as illustrated below).

When we consider heavier and more frequent substance use, rates are lower but the same developmental gradient is clear. In 2011, across the three grade levels, respectively, 30-day rates were as follows: 7 %, 18 %, and 23 % reported any marijuana use; 3 %, 5 %, and 9 % reported any illicit drug use other than marijuana; 13 %, 27 %, and 40 % reported any alcohol use; 4 %, 14 %, and 25 % reported any drunkenness; and 6 %, 12 %, and 19 % reported any cigarette use (Johnston et al., 2012). In terms of binge drinking (defined here as having 5 or more drinks in a row in the past 2 weeks), 2011 rates were 6 %, 15 %, and 22 % across the three grade levels, respectively.

In Historical and International Perspective

At the population level, adolescent substance use is best viewed as a moving target, and compared to the recent past, the 2011 rates reflect salutary movement. In considering the past two decades, illicit drug, alcohol, and cigarette use generally peaked in the middle to the late 1990s. The lifetime rates for marijuana use in 1997, a peak year, were 23 %, 42 %, and 50 %, and rates for illicit drug use other than marijuana were 18 %, 25 %, and 30 %, respectively, across 8th, 10th, and 12th graders; these 1997 rates are significantly higher than all the corresponding 2011 rates, particularly for 8th and 10th graders (Johnston et al., 2012). Rates of lifetime alcohol use and drunkenness have also declined over the past two decades, with most of this reduction occurring since 2001. In 1993, a peak year for alcohol use, lifetime rates of alcohol use were 56 %, 72 %, and 80 % and of drunkenness were 26 %, 48 %, and 63 %, respectively, across the three grade levels; all of these 1993 rates are significantly higher than the 2011 rates, especially for 8th and 10th graders. Cigarette use has dropped extensively over the past two decades; lifetime cigarette use peaked in 1996 with rates of 49 %, 61 %, and 64 %, respectively, rates over twice as high as 2011 rates for 8th and 10th graders.

One important question regarding these historical shifts pertains to the causes of such shifts. Attempting to isolate causes of historical change in adolescent substance use, or any given behavior, is complex given the likely multiple influences and the need to distinguish among cohort, period, and age effects. Nonetheless, one consistent precursor to historical changes in alcohol and marijuana use is changes in disapproval of such use (Johnston et al., 2012). In a recent analysis that contrasted age, period (year of measurement), and cohort effects of population-based social norms (based on disapproval) about heavy alcohol use on individual level heavy drinking during adolescence, cohort effects were found to predominate; being part of a birth cohort that was higher on disapproval set the stage for lower alcohol use (Keyes et al., 2012), suggesting the power of social norms in shaping historical trends in behavior. Other likely substance-specific causes include increases in the cost of cigarettes (Tauras, O'Malley, & Johnston, 2001) and changes in legislation regarding medical use of marijuana (Cerdá, Wall, Keyes, Galea, & Hasin, 2012). More generally, adolescent substance use tends to be cyclical, with epidemics of various drugs (e.g., cocaine, ecstasy, LSD) appearing and receding. Johnston (1991) uses the term "generational forgetting" to describe why rates can increase relatively quickly following a period of low use. Pain and loss resulting from high-profile drug-related tragedies such as celebrity deaths, as well as from local accidents or overdoses, may be forgotten during periods of low use. If society in general, and new generations of youth in particular, stops viewing substance use as dangerous, this absence of caution may allow for use to come roaring back, triggering new tragic experiences, and so on.

Another important question regarding historical shifts is whether declines summarized above in the lifetime rates are also seen in rates of heavier and more frequent use. The answer is yes, that the proportions of decline from recent peaks in the past two decades have been remarkably similar across different frequencies and levels of use (Johnston et al., 2012), suggesting that historical shifts reflect similar changes for experimental and heavier use. Important exceptions pertain to adolescents at the very deep end of substance use. For example, daily marijuana use has shifted little since the late 1990s (as of 2011, rates were 1.3 %, 3.6 %, and 6.6 % across the three grade levels, respectively; Johnston et al., 2012).

A third important question regarding historical shifts is whether they pertain equally well across the different grade levels. In fact, they do not: Although most rates have declined since their recent peaks for all three grade levels, the proportional declines have generally been greater for 8th and 10th graders than 12th graders and greater for 8th graders than 10th graders (Johnston et al., 2012). That is, more adolescents are waiting longer to begin and to escalate their substance use now compared to the mid to late 1990s. Effectively, this means that the developmental

gradient noted above for both onset and continued use is stronger now than in the past. Thus, compared to peak rates across the past two decades, current rates of substance use among US adolescents are all considerably lower, especially for the 8th and 10th graders.

Adolescents in the United States have considerably lower rates of cigarette and alcohol use compared to European adolescents. Based on a 2011 cross-national survey of 15 and 16 year olds, US adolescents were at the lowest end of the distribution (Hibell et al., 2012). However, rates of marijuana and other illicit drug use were generally higher among US adolescents compared to European adolescents, with US adolescents typically being near the top of the distribution. This unique US configuration, compared to the typical European rank-order consistency across substance use measures, likely has many causes including the large historical decline of cigarette use among US adolescents only, as well as the typically higher rates of alcohol use in many European countries due in part to lower legal drinking ages.

Thus, the evidence suggests that currently, US adolescents are better off than previous cohorts and their contemporaries in Europe in terms of cigarette and alcohol use and better off than previous US cohorts (though worse off compared to European contemporaries) in terms of marijuana and other illicit drugs. Nonetheless, we cannot be complacent with the facts, for example, that "only" one in ten 8th graders reports using an illicit drug other than marijuana (e.g., cocaine, heroin, hallucinogens) at least once already in their lifetime, that one in five 10th graders reports using marijuana at least once in the past month, or that one in five 12th graders reports having 5 or more drinks in a row at least once in the past two weeks (Johnston et al., 2012). Furthermore, despite the overall decline in many substances, some especially dangerous drugs have not declined including the misuse of prescription drugs. Over the past decade, 12th grade annual rates of misuse (i.e., use not under doctor's orders) of any prescription drug have remained steady at about 15 %, and specifically misuse of narcotics other than heroin (e.g., OxyContin, Vicodin) has remained steady at about 9 %. Of special importance, marijuana use has been increasing again recently especially among 12th graders (Johnston et al., 2012).

Sociodemographic Variation in Substance Use

Substance use involvement varies considerably by sociodemographic characteristics, especially gender, socioeconomic status (SES), and race/ethnicity. At 12th grade, boys are more likely to use just about every substance and at higher frequencies than girls (Johnston et al., 2012). But at 8th grade, rates are much more equivalent across boys and girls, with girls being higher on the use of some substances, including use of any illicit drug other than marijuana. Thus, gender differences in substance use emerge and expand across adolescence, with the increase in substance use being greater for boys.

In contrast, SES differences tend to shrink across adolescence. At 8th grade, lower SES youth have higher rates of almost all substances, but by 12th grade, there are far fewer SES differences in substance use (Johnston et al., 2012). Notable exceptions include cigarette, cocaine, and heroin use, which are still higher among lower SES youth by 12th grade; in addition, higher SES youth catch up with and surpass their lower SES age-mates by 12th grade in terms of alcohol use and drunkenness. Much of this reflects developmental timetable variation by SES: It has long been known that adolescents from more working class backgrounds tend to start earlier with risky behaviors including substance use (Ianni, 1998) and then their higher SES age-mates catch up by the end of high school (Bachman et al., 2008; Crosnoe, 2011).

In terms of racial/ethnic differences, African American youth tend to have the lowest rates of almost all substances and at all frequency/quantity levels compared to other youth, especially at 12th grade, although differences are typically evident at the earlier grades as well (Johnston et al., 2012). Explanations for this lower use include higher levels of religiosity

(e.g., Wallace et al., 2007). Hispanic youth tend to have the highest lifetime rates of substance use at 8th grade, but by 12th grade, White youth have the highest lifetime usage rates of many illicit drugs including marijuana, as well as of alcohol and cigarettes (Johnston et al., 2012; Wallace et al., 2003). Rates of substance use vary in important ways within these large sociodemographic groups. For example, rates vary significantly among Hispanic subpopulations (Delva et al., 2005). Similarly, when considering SES by race/ethnicity interactions, the SES gradient noted above generally applies more to White youth than to African American and Hispanic youth (Bachman, O'Malley, Johnston, Schulenberg, & Wallace, 2011).

Despite lower prevalence of substance use during adolescence, racial/ethnic minorities, particularly African Americans, tend to experience higher rates of negative consequences of substance use compared to Whites beginning in young adulthood, including higher rates of drug-related criminal justice involvement (Brown, Flory, Lynam, Leukefeld, & Clayton, 2004; National Institute on Drug Abuse, 2003) and psychiatric and substance use disorders (Gil, Wagner, & Tubman, 2004; Reardon & Buka, 2002). Therefore, it is important to consider the potential roots in adolescence of these racial/ethnic disparities in consequences of youth substance use despite relatively lower prevalence of use among some groups.

Developmental Concepts: Foundations for Understanding Substance Use Etiology

At the individual level, adolescent substance use is also best understood as a moving target, embedded within the many other developmental changes happening within young people and their social worlds. Through a series of conceptual papers and chapters, we have elaborated a developmental framework regarding substance use during adolescence and the transition to adulthood concerning continuity and discontinuity, trajectories of behaviors and attitudes, and intraindividual and social transitions (e.g., Maggs & Schulenberg, 2005a, 2005b; Maggs, Schulenberg, & Hurrelmann, 1997; Patrick & Schulenberg, 2014; Patrick, Schulenberg, Maggs, & Maslowsky, in press; Schulenberg et al., 1997, 2003; Schulenberg & Maggs, 2002; Schulenberg & Maslowsky, 2009; Schulenberg & Patrick, 2012; Schulenberg, Sameroff, & Cicchetti, 2004; Schulenberg & Zarrett, 2006). Our framework, consistent with a broad interdisciplinary developmental science perspective, highlights multilevel and multidirectional changes characterized by mutual selection and accommodation of individuals and their contexts (Cairns, 2000; Elder & Shanahan, 2006; Lerner, 2006; Sameroff, 2010). We view individuals and contexts as playing strong, active roles in the process of development, highlighting the importance of the person–context match, the connection between what the developing individual needs and what the context provides. Individuals select particular contexts and activities based on opportunities and personal characteristics and competencies. Selected contexts then provide additional opportunities—and effectively limit other opportunities represented by contexts not selected—for continued socialization and further selection. This progressive accommodation suggests the qualities of coherence and continuity in development. However, consistent with our emphasis on person–context interactions and multidirectional change, development does not necessarily follow a smooth and progressive function and early experiences do not always have strong or lasting effects (Lewis, 1999; Rutter, 1996). Thus, both continuity and discontinuity are expected across adolescence and the transition to adulthood. In this subsection, we summarize broad-based developmental concepts relevant to understanding the etiology of adolescent substance use including continuity and discontinuity and developmental transitions.

Continuity and Discontinuity

Although the concepts of continuity and discontinuity are central to the understanding of development (Kagan, 1980; Werner, 1957), they are not

easily defined. Stability and continuity are sometimes used interchangeably, but the two are typically viewed as distinct among developmental scientists: Stability pertains to the extent to which individuals maintain relative rank ordering over time and continuity pertains to the course of intraindividual trajectories (Lerner, 2006). Two uses of the concepts of continuity and discontinuity are common (Schulenberg et al., 2003; Schulenberg & Zarrett, 2006), and both are relevant to understanding the etiology of substance use.

First, continuity and discontinuity can be considered in terms of causative linkages across the life span (Lewis, 1999; Masten, 2001), termed ontogenetic continuity and discontinuity. Ontogenetic continuity reflects a progressive and individual coherence perspective, in which earlier events and experiences are viewed as formative and essentially causing future outcomes (Caspi, 2000). As would be expected from a development perspective, continuity tends to prevail across life, and what we see in much of adolescent substance use is "the result" of earlier difficulties and family socialization experiences (Dodge et al., 2009; Zucker et al., 2008). But it is not that simple and early functioning does not always determine later functioning (Cicchetti & Rogosch, 2002; Lewis, 1999); instead, the effects of early experiences may be neutralized or reversed by later experiences. This focus on developmentally proximal influences reflects an ontogenetic discontinuity perspective, whereby current functioning is due more to recent and current contexts and experiences than to earlier ones (Schulenberg & Zarrett, 2006). The roots of substance use for some adolescents do not go that far into the past, but rather into current social contexts and individual tasks. The distinction between ontogenetic continuity and discontinuity is important when examining the etiology of substance use. Ongoing childhood difficulties that culminate in substance use likely reflect ontogenetic continuity (e.g., life-course-persistent antisocial behavior; Moffitt & Caspi, 2001); in contrast, a positive developmental trajectory during childhood followed by involvement with substance use in adolescence likely reflects ontogenetic discontinuity (e.g., adolescence-limited antisocial behavior; Moffitt & Caspi, 2001).

Second, continuity and discontinuity can be considered as having both descriptive components (pertaining to manifest behaviors) and explanatory components (pertaining to underlying purposes, functions, and meanings; Kagan, 1980; Lerner, 2006). Homotypic continuity refers to the presence of both descriptive and explanatory continuity whereby both a given behavior (e.g., alcohol use) and the underlying purpose of that behavior (e.g., have fun with friends) remain continuous over time. Heterotypic continuity refers to when behaviors vary across time (descriptive discontinuity) while the underlying purpose or meaning of those varying behaviors remains the same (explanatory continuity). For example, although success in peer relations may be continuous from childhood into adolescence, what it takes to be successful with peers may shift over time and may cross into deviant behaviors during adolescence (Allen, Porter, McFarland, Marsh, & McElhaney, 2005). Functional discontinuity occurs when the manifested behavior appears unchanged yet the underlying function or meaning of that behavior changes over time (i.e., descriptive continuity, explanatory discontinuity). For example, a 14-year-old adolescent may first use marijuana to experiment and fit in with her friends; four years later, she still uses marijuana, but as a means of coping with stress. As we summarize later, we have found in our research such developmental shifts in substance use reasons and behaviors.

Developmental Transitions

The period between the end of childhood and the beginning of adulthood is dense with internally and externally based transitions (Schulenberg et al., 1997). Developmental transitions include transformations in individuals, their contexts, and the relations between individuals and their contexts across the life course (Bronfenbrenner, 1979; Schulenberg & Maggs, 2002). These include both global transitions (e.g., transition to adolescence) and more specific and interlinked intraindividual transitions (e.g., biological, identity-related)

and socially based external ones (e.g., parent–child relations, school-related; Rutter, 1996). The power of the interlinked transitions in the individuals' lives, specifically in the course of substance use, can be understood in relation to the concepts of continuity and discontinuity discussed above. Transitions can contribute to ontogenetic discontinuity in ongoing trajectories in several ways, such as by overwhelming coping capacities or worsening the person–context match (Coleman, 1989; Schulenberg & Zarrett, 2006). By providing "shocks to the system," transitions can serve as proximal effects that can counteract developmentally distal effects.

This discontinuity in ongoing trajectories can take the form of turning points or developmental disturbances. Turning points reflect long-term changes in course (Elder & Shanahan, 2006; Rutter, 1996), such as escalating substance use during the transitions to middle and high school (Guo, Collins, Hill, & Hawkins, 2000; Jackson & Schulenberg, 2013), as well as to residential college (Schulenberg & Patrick, 2012; White et al., 2006). Transitions as turning points can also be viewed in terms of heterotypic continuity (descriptive discontinuity/explanatory continuity) and functional discontinuity (descriptive continuity/explanatory discontinuity) whereby the connection between behaviors and underlying purposes or meanings shifts. Entering high school where some forms of drinking become more normative may make alcohol use less a function of deviance and more a function of social integration (Crosnoe, 2011). In contrast to the "permanent change" associated with turning points, developmental disturbances reflect more momentary perturbations (Schulenberg & Zarrett, 2006). Once individuals are given time to adjust, they might resume their prior ongoing trajectory. In such cases, a transition may simply result in short-term deviance (e.g., increased binge drinking, affiliation with a more deviant peer group) and may not have long-term effects on developmental course or predict later functioning in adulthood (Schulenberg et al., 2003). Of course, not all discontinuity reflects maladaptation—for example, a school transition may result in a better person–context match in terms of appropriate level of challenge and contribute to improved health and well-being.

Although the power of transitions may be more obvious in the case of discontinuity, transitions also contribute to continuity, with transitional experiences serving as proving grounds that help consolidate and strengthen ongoing behavioral and adjustment trajectories for better and worse (Schulenberg & Zarrett, 2006). Individuals tend to rely on intrinsic tendencies and known behavioral and coping repertoires in novel and ambiguous situations (Caspi, 2000; Dannefer, 1987). This accentuation effect suggests that young people already experiencing difficulties may have trouble negotiating new transitions and fall further behind their well-functioning peers; in contrast, those already doing well have the resources to deal successfully with new transitions and climb further ahead of their age-mates having difficulties (e.g., Rudolph & Troop-Gordon, 2010; Schulenberg et al., 2003). Thus, during major transitions such as puberty or the transition into high school, ongoing salutary and deviancy trajectories may become more solidified highlighting the role of transitions in perpetuating ontogenetic continuity.

Risk Factors for Adolescent Substance Use

The list of adolescent risk factors for substance use is extensive connecting to most if not all aspects of adolescent development, a fundamental premise of Problem Behavior Theory (Jessor, 1987). In a 1992 comprehensive review of the literature on risk factors for adolescent substance use, a review that remains quite useful over two decades later, Hawkins, Catalano, and Miller classified the multitude of risk factors into 17 different categories. These included contextual risk factors (e.g., availability of substances, economic deprivation, family conflict), individual risk factors (e.g., academic failure, early onset of problem behaviors), and physiological risk factors including genetic background. A few years later, Petraitis, Flay, and Miller (1995) summarized 14 theoretical models for understanding experimental

substance use during adolescence, ranging from sociological theories focusing on more distal socio-structural mechanisms (e.g., an absence of commitments to conventional society) to cognitive-affective theories emphasizing more proximal processes (e.g., decision making) and mechanisms (e.g., substance-specific expectancies). Since then, the list of risk factors and mechanisms has certainly expanded (see, e.g., Brown et al., 2008; Chassin et al., 2009; Dodge et al., 2009; Windle et al., 2008; Zucker et al., 2008). The recognition of these multiple risk factors and mechanisms highlights the probabilistic nature of risk factors (Maggs & Schulenberg, 2005a)—i.e., none is sufficient or necessary for particular outcomes, thus requiring conceptualizations of explanatory processes that focus on the diversity of causal connections (Cairns, 2000). In this subsection, we provide an illustrative overview of common and interconnected risk and protective factors embedded within the multiple tasks and transitions of the second decade of life.

Biological and Physical Changes

Pubertal development during early adolescence is characterized by a rapid acceleration in growth and the development of primary and secondary sex characteristics, and by the end of high school, most adolescents have attained full adult height and reproductive capacity (Susman & Dorn, 2009). These physical and hormonal changes along with societal expectations combine to increase adolescents' interest in and tolerance of alcohol and other psychoactive substances (Spear, 2007). Adolescents who experience earlier pubertal development relative to their peers (i.e., early maturers) are more likely to associate with older and more deviant peers (Downing & Bellis, 2009; Mendle & Ferrero, 2012; Negriff & Trickett, 2012), compounding the effects of early physical transitions with earlier transitions to unsupervised time with peers. Thus, in addition to increasing access to substances, these multiple simultaneous transitions may overload the young person's coping capacity (Coleman, 1989) and alter the person–context match (Susman & Dorn, 2009), setting the stage for discontinuities in terms of substance use onset. In contrast, through accentuation of pre-transition individual characteristics, early pubertal timing can contribute to continuities in ongoing trajectories of health and well-being (e.g., Rudolph & Troop-Gordon, 2010).

Cognitive and Neurological Changes, Sensation Seeking, and Risk Taking

Across adolescence, important normative transformations in cognitive reasoning abilities occur, including increases in the ability to think abstractly, consider theoretical possibilities, and view issues as relative rather than absolute (Keating, 2004). These changes are increasingly understood to occur in the context of functional and structural changes occurring in the adolescent brain (Blakemore, 2012; Doremus-Fitzwater, Varlinskaya, & Spear, 2010; Sturman & Moghaddam, 2011). As cognition and reasoning mature, adult-defined reality becomes viewed by the adolescent as simply one of many possible perspectives. Adolescents are able to engage in increasingly sophisticated deliberations regarding which behaviors to engage in and why, with specific end goals in mind (Gibbons, Houlihan, & Gerrard, 2009; Maslowsky, Buvinger, Keating, Steinberg, & Cauffman, 2011; Maslowsky, Keating, Monk, & Schulenberg, 2011; Reyna & Farley, 2006). It is often assumed that adolescents engage in higher levels of risk taking because they think they are invincible or invulnerable, able to avoid harm regardless of their own behavior (Elkind, 1967; Romer & Jamieson, 2001). However, research contrasting the decision making of adolescents and adults has generally not supported clear age differences in thoughts of invincibility or in downplaying risks of certain behaviors (Johnson, McCaul, & Klein, 2002). In fact, adolescents engaged in more frequent risk behavior rate their likelihood of negative consequences highest, indicating their appreciation of the relative risks involved in their behavior (Fromme, Katz, & Rivet, 1997).

Additional evidence suggests that adolescents are particularly attuned to the potential benefits of engaging in risky behavior such as substance use. Risky behavior is likely to yield social rewards salient to adolescents such as peer approval (O'Brien, Albert, Chein, & Steinberg, 2011). In addition, neurobiological evidence suggests that the development of rewards systems outpaces that of inhibitory systems during adolescence, leading to an over-prioritization of rewards during this period (Galvan, Hare, Voss, Glover, & Casey, 2007), though not all evidence suggests this mismatch (Crone & Dahl, 2012). Providing both neurophysiological and social rewards, substance use is a clear candidate for a risky behavior that yields sought-after benefits. The power of such benefit-seeking motives is evident in the extensive literature linking sensation seeking and substance use. Sensation seeking, originally defined by Zuckerman (1979) as "the need for varied, novel, and complex sensations and experiences" (p. 10), peaks in adolescence and is a strong predictor of engagement in risky behavior and substance use (Dever et al., 2012; Patrick & Schulenberg, 2010; Steinberg et al., 2008). Growing evidence demonstrates the neurological bases of heightened sensation seeking and reward seeking and their associations with substance use during adolescence (Doremus-Fitzwater et al., 2010).

Clearly, not all adolescent substance use is premeditated or executed in a deliberate search for benefits. Particularly as group-level activities, substance use and associated behaviors may not always represent planned or rationally considered choices. Decisions about how much *more* to drink or use or about whether to engage in other risky behaviors are often made when individuals do not have the benefit of being sober. Theoretically, decision-making models are useful for understanding these choices (Reyna & Farley, 2006). And practically, these choices may make the difference between light/moderate drinking and more harmful binge drinking. Consideration of contemporaneous intra- and interpersonal factors is crucial to understanding the role of new cognitive abilities and architecture in adolescents' onset and escalation of substance use (Crone & Dahl, 2012).

Identity and Motivations for Substance Use

Adolescents experience fundamental changes in their self-definition and identity (Cote, 2009; Erikson, 1968; Marcia, 1994). Although normative and part of healthy development, identity exploration may also represent a risk factor for experimentation with alcohol or other drug use (Maggs et al., 1997; Marcia, 1994). Thus, the role played by experimenting with substances in adolescents' lives can be paradoxical (Maggs et al., 1995): Despite the possibility of serious harm, substance use may serve important constructive functions, including identity exploration (Chassin, Presson, & Sherman, 1989; Jessor, 1987).

Motivations (or reasons) for substance use can provide an important window into the individual "why" of substance use, how it relates to identity exploration, to peer bonding, and to coping with pressure and disappointment. Four main types of substance use motivations—social, enhancement, coping, and conformity—have been differentiated, with research predominantly focusing on alcohol and marijuana use reasons (Bonn-Miller, Zvolensky, & Bernstein, 2007; Cooper, 1994; Simons, Correia, & Carey, 2000). Reasons for alcohol use and marijuana use change developmentally. For instance, 12th grade adolescents tend to be higher on drinking to get drunk (as well as other social and coping reasons for drinking) than young adults, but lower on drinking to relax (Patrick & Schulenberg, 2011). Motivations show important associations with current and future use. For example, an increase in binge drinking from ages 18 to 22 is most strongly correlated with concurrent reasons of using alcohol to get drunk and to relieve boredom; however, a trajectory of continued binge drinking after age 22 is most strongly related to concurrent reason of using alcohol to get away from problems (Patrick & Schulenberg, 2011). This illustrates the notion of functional discontinuity, where binge drinking remains the same but the underlying reason for binge drinking shifts toward a more problematic purpose. Reasons for use reported in 12th grade also show long-term associations with symptoms of alcohol use disorders.

Drinking to get drunk in 12th grade predicts concurrent and future increases in heavy drinking (Schulenberg, Wadsworth, O'Malley, Bachman, & Johnston, 1996) as well as alcohol use disorders at age 35 (Patrick, Schulenberg, O'Malley, Johnston, & Bachman, 2011). In contrast, peer conformity reasons for use tend to be less predictive of future alcohol use (Patrick et al., 2011), suggesting that this "why" of alcohol use has more to do with ephemeral peer connections than with the individual experience of alcohol use—i.e., a less solid connection with identity.

Externalizing Behaviors and Internalizing Symptoms

Childhood and adolescent mental health and behavioral problems, particularly externalizing behaviors and internalizing symptoms, show clear associations with adolescent substance use (Dodge et al., 2009; Zucker et al., 2008). Externalizing behaviors, like theft, property destruction, and aggression that violate social or legal norms (Hinshaw, 1987), have a strong, positive association with alcohol, cigarette, and marijuana use during adolescence (Brook, Zhang, & Brook, 2011; Ellickson, Tucker, Klein, & McGuigan, 2001; Maslowsky & Schulenberg, 2013; Reboussin, Hubbard, & Ialongo, 2007).

Empirical evidence regarding the association of internalizing symptoms (depressive symptoms, anxiety, related constructs such as self-derogation) and substance use during adolescence is inconsistent. Particularly with regard to depressive symptoms, studies have found negative, positive, and null relations to substance use during adolescence (Dodge et al., 2009; Goodman & Capitman, 2000; McCaffery, Papandonatos, Stanton, Lloyd-Richardson, & Niaura, 2008). Notably, while the main effect association of depressive symptoms and substance use is small, there are large interactions between depressive symptoms and externalizing behaviors in the prediction of substance use, particularly among younger adolescents; that is, adolescents with high levels of both are especially likely to engage in substance use (Maslowsky & Schulenberg, 2013). Anxiety symptoms and disorders are more consistently shown to be positively associated with adolescent substance use (e.g., Costello, Mustillo, Erkanli, Keeler, & Angold, 2003), suggesting a coping or self-medicating function of substance use.

Of course, a primary issue is the direction of causality among internalizing, externalizing, and substance use. Internalizing and externalizing generally precede the onset of substance use, emerging on average 3–4 years before substance use in adolescence (Kessler et al., 2005; O'Neil, Conner, & Kendall, 2011). Thereafter, it is likely that substance use both contributes to and is caused by internalizing and externalizing behaviors. For example, substance use may relate to spending unsupervised time with peers and consequently to the onset of additional externalizing behaviors (Osgood, Wilson, O'Malley, Bachman, & Johnston, 1996). Although there is some evidence that substance use is a risk factor for onset and acceleration of depression and anxiety later in adolescence and into early adulthood (Brook, Cohen, & Brook, 1998; Stice, Burton, & Shaw, 2004), the majority of studies to date indicate that internalizing symptoms and disorders tend to precede substance use in adolescence (O'Neil et al., 2011).

Family

Adolescence is a period of significant reorganization and change in family relationships. Such normative transformations include increased autonomy and independence from parents, but ideally these changes occur in a context of continued support and attachment between developing adolescents and their parents (Laursen & Collins, 2009). The quantity of interaction often decreases, and more time is spent in contexts outside the family such as at school, with peers, and at work (Larson, Richards, Moneta, Holmbeck, & Duckett, 1996). Nonetheless, parents still play a pivotal role in adolescent experiences and in fact can sometimes counter other risk factors for alcohol and other drug use.

Parental supervision and monitoring tend to be strong predictors of lower alcohol and other

drug use among adolescents (Kiesner, Poulin, & Dishion, 2010; Pilgrim, Schulenberg, O'Malley, Bachman, & Johnston, 2006) and are especially protective against substance use for high risk-taking adolescents (Dever et al., 2012). Alcohol use tends to increase as adolescents become more individuated from parents (Baer & Bray, 1999) and as parental monitoring tends to lessen (Barnes, Reifman, Farrell, & Dintcheff, 2000). Parents also protect against adolescent substance use through positive, supportive interactions and relationships with their children (Brody et al., 2006); indeed, the argument is made that parental monitoring during adolescence reflects more the quality of the relationship than actual independent monitoring by parents (Kerr & Stattin, 2000). In one study, levels of parental support during early adolescence protected against alcohol use five years later, with direct effects on alcohol use as well as indirect associations mediated by the effect of parental support on parental monitoring (Barnes et al., 2000). Parental support is particularly important in protecting against substance use for adolescents in high-risk environments as parents increase supportive behavior to protect their children from dangerous contexts (Rankin & Quane, 2002).

Parents also exert influence on substance use indirectly through their influence on their children's selection of peers and on the extent to which their children are susceptible to the influence of their peers. Adolescents who report higher levels of parental involvement in their lives also report that they are less influenced by their peers, suggesting a protective effect (Wood, Read, Mitchell, & Brand, 2004). While peers play an important in-the-moment role in substance use, it is likely that parents' influence is in effective monitoring and laying a foundation for decision making and peer selection that sets the stage for adolescent choices (Kandel, 1985; Kiesner et al., 2010; Urberg, Luo, Pilgrim, & Degirmencioglu, 2003).

Regarding sibling influences, some evidence suggests that older siblings' substance use predicts early adolescents' alcohol expectancies (D'Amico & Fromme, 1997) and subsequent substance use, above and beyond parental predictors (Duncan, Duncan, & Hops, 1996; Kelly et al., 2011; Low, Shortt, & Snyder, 2012). Behavior genetic studies contrasting biological and adoptive siblings also suggest that, unlike many other sibling similarities and parental "influences" that can be explained by passive genotype–environment interactions, sibling similarities in the area of adolescent alcohol use involve important environmental effects (McGue & Sharma, 1995), such as sibling modeling, social influence, and access to substances (Conger & Rueter, 1996; Mercken, Candel, Willems, & de Vries, 2007). Sibling relationships can also be protective against substance use. As with parents, having a close or supportive relationship with a sibling is associated with lower rates of substance use in adolescence (East & Khoo, 2005; Samek & Rueter, 2011). In sum, despite normative transitions toward independence during adolescence, it is clear that the family context, and the sibling and parent relationships embedded within it, continues to exert both direct and indirect effects on substance use.

Peers

The importance of peer relations rises during adolescence, increasing the young person's exposure to cultural norms and influences that may or may not be compatible with the norms and values of the family of origin (Brown & Larson, 2009), providing avenues for continuity and discontinuity. Adolescent development in general, and substance use in particular, is inextricably linked to changing peer relationships (Patrick et al., in press; Prinstein & Dodge, 2008). There tends to be a shift in what is viewed as markers of status and success in peer groups toward more deviant activities (Allen et al., 2005), reflecting heterotypic continuity. Clearly, peer influences are not monolithic in their power or direction of influence (Brown & Larson, 2009). Individuals tend to seek out and be selected by peers who have similar goals, values, and behaviors (Kandel, 1985; Prinstein & Dodge, 2008), and thus peer relations relate to both using and not using substances. Peer influence tends to increase through

at least middle adolescence, due to an intensification of peer relationships and a relatively immature ability to resist peer influence (O'Brien et al., 2011; Schulenberg et al., 1999; Steinberg & Monahan, 2007).

Having friends who get drunk is among the strongest risk factors for alcohol use (Patrick & Schulenberg, 2010), and perceptions of friends' use in high school predict both concurrent binge drinking and future trajectories of binge drinking (Schulenberg et al., 1996). Of course, a main issue when it comes to the correlation between peer use and individual use is whether this is due to socialization (with peers contributing to adolescents substance use) or selection (with adolescents selecting friends with similar interests); during adolescence and the transition to adulthood, it is typically both (Kandel, 1985; Patrick et al., in press). Over time, this is likely a matter of progressive accommodation, where adolescents select like-minded friends who in turn provide strong socialization influences, and so on (Cairns, 2000; Schulenberg et al., 1999).

Overall, at least four kinds of influences in the peer domain may contribute to increased substance use during adolescence (Patrick et al., in press). First, modeling is a form of indirect peer pressure. Adolescents learn by watching the substance use behaviors of peers and family members and perceiving the rewards and punishments they experience. Part of this modeling is learning how to talk about substance use, including instances of ridicule or exclusion for adolescents who do not engage in substance use (Brown & Larson, 2009; Dishion, Spracklen, Andrews, & Patterson, 1996; Patterson, Dishion, & Yoerger, 2000). Second, similarities between adolescents and their friends encourage continuity of behavior over time as peers spend time in unstructured socializing (Haynie & Osgood, 2005; Kandel, 1985; Osgood et al., 1996). The frequency of evenings out with friends (unsupervised by adults) is consistently associated with more alcohol and other drug use (Bachman et al., 2008; Kiesner et al., 2010; Patrick & Schulenberg, 2010). Third, adolescents tend to significantly overestimate the prevalence of substance use among their age-mates and then seek to match their perceptions of others' use (Olds & Thombs, 2001). Finally, sociability that is expressed while drinking and using other drugs can be seen as indicators of successful peer relationships and markers of social group bonding (Crosnoe, 2011; Maggs et al., 1995), underscoring the role of heterotypic continuity in peer success across adolescence.

School and Work

Adolescents typically face major educational and occupational transitions every few years. These transitions represent potentially powerful risks and opportunities for young people. Successful adaptation to and performance in educational and occupational domains help define concurrent and future optimal development (Clausen, 1991; Crosnoe, 2011). In contrast, difficulties in negotiating these critical transitions can contribute to cumulative and emergent health risks (Eccles & Roeser, 2009), including substance use difficulties (Crosnoe, 2011; Schulenberg & Maggs, 2002). The transition to middle school is often marked by increased mismatch between what the developing young person expects and needs and what the context provides (Eccles & Roeser, 2009); the transition to high school can be marked by similar mismatches along with increased stress due to heightened expectations for individual responsibility for success (Guo et al., 2000; Jackson & Schulenberg, 2013), which may contribute to increased alcohol and other drug use.

Several cross-sectional and longitudinal studies provide evidence that grades, educational expectations, and school bonding are negatively related to alcohol and other drug use; likewise, school disengagement, school failure, school misbehavior, and skipping school are positively related to alcohol and other drug use (e.g., Bachman et al., 2008; Li & Lerner, 2011; McCluskey, Krohn, Lizotte, & Rodriguez, 2002; Pilgrim et al., 2006). For example, in a longitudinal multilevel regression analysis, school misbehavior and perceived peer encouragement of misbehavior in 8th grade predicted concurrent substance use and increases in substance use

across high school; likewise, school bonding, school interest, and academic achievement at 8th grade predicted lower concurrent and future substance use (Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003). Of particular importance, positive school attitudes were stronger protective factors against substance use for low-achieving students. Although it is clear that substance use can contribute to educational difficulties, broadly defined, it appears that the more common direction of influence, based on longitudinal analyses that accounted for selection factors, is that school difficulties contribute to substance use during adolescence (Bachman et al., 2008).

During high school, most US adolescents make the transition into part-time work. Although it has long been recognized that hours of work during adolescence are positively related to use of alcohol and other drugs, conclusions about causal connections have remained elusive (Mortimer, 2003; Staff, Messersmith, & Schulenberg, 2009). It is likely that some part-time work, especially in jobs that are a source of stress or mismatch between hopes and opportunities, contributes to substance use. Yet most of the evidence suggests that the positive relationship between hours of work and alcohol and other drug use is due more to selection effects—i.e., that long hours of work and substance use have a common set of causes, particularly disengagement from school (Bachman, Staff, O'Malley, Schulenberg, & Freedman-Doan, 2011; Monahan, Lee, & Steinberg, 2011).

Conclusions and Implications

As we argue in this chapter, adolescent substance use is best viewed as a moving target, both in terms of historical trends and developmental course. It is encouraging that current cohorts of adolescents are less likely than earlier cohorts to get involved with substance use; they have lower rates of initiation and escalation of most forms of substance use, especially among 8th and 10th graders (Johnston et al., 2012). Indeed, the age gradients of most substance use have become more pronounced as rates have dropped over the years more so for younger than older youth. Nonetheless, rates of some substances have not declined and some are rising again. In particular, the misuse of prescription drugs has remained steady over recent years and marijuana use has started to increase especially among older adolescents. As we have learned through four decades of monitoring adolescent drug use, the situation can and likely will change. Thus, in terms of prevention and policy efforts, there are still plenty of reasons to worry about adolescent drug use. More generally, understanding the larger context in terms of shifting national trends in substance use and age trends in use, as well as broader sociodemographic differences in use, provides an important reference point for understanding individual adolescent development.

Broad-based concepts regarding developmental continuity, discontinuity, and transitions help highlight the dynamic aspect of functioning and adjustment during adolescence, drawing out the need to consider adolescent substance use with developmentally distal and proximal templates. For many young people, substance use during adolescence reflects a cascading effect whereby earlier difficulties in a variety of domains contribute to substance use onset and escalation, which then cascades into other difficulties (Dodge et al., 2009; Masten et al., 2008); likewise, we can view avoiding substance use during adolescence in the same way, a result of earlier positive cascades. Such cascading effects represent ontogenetic continuity (Schulenberg & Maslowsky, 2009). In contrast, partly as a function of the numerous individual and social context transitions during adolescence, this cascading flow can get interrupted or diverted, resulting in ontogenetic discontinuity whereby, for example, substance use and other risky behaviors during adolescence are more the result of developmentally proximal individual and contextual characteristics than distal ones (Moffitt & Caspi, 2001). This can be understood in terms of the peer and social integration benefits of substance use and other risky behaviors, illustrating heterotypic continuity in which the purpose of being successful in peer relations remains consistent over time but the behaviors to meet this purpose shift. In some cases, this behavioral

discontinuity may prove to be a developmental disturbance (Schulenberg & Zarrett, 2006), and more salutary behavior trajectories are expected to eventually resume. But in other cases, this "detour into the dark side" that may come with the multiple transitions of adolescence is best understood as a turning point—this sort of behavioral discontinuity suggests a profound and permanent change in course (Rutter, 1996). Future advances in the understanding of the etiology of substance use rest upon our ability to distinguish among these distinct types of continuity and discontinuity within the multiple transitions that comprise the second decade of life.

It is no surprise that adolescence is the typical time for substance use onset and escalation. There are numerous risk and protective factors for substance use during adolescence—in fact, it would be difficult to find aspects of adolescence that do not relate to substance use. Based on the research over the past several decades, a reasonable assumption is that we will discover few new substance use risk or protective factors. Instead, new discoveries will come from understanding how risk and protective factors are interlinked over time and how mechanisms across levels of explanation work together or in competition to result in substance use onset, escalation, and desistence. The next waves of innovative substance use research will involve integrating multiple levels of analysis (Cicchetti & Dawson, 2002; Crone & Dahl, 2012; Hyde, Gorka, Manuck, & Hariri, 2011), spanning from brain and biology to behavior and its effects on the health and well-being of the population. Gaining a better understanding of which configurations of risk and protective factors differentiate more experimental use from more chronic use, moving the lens from point estimates to trajectories, will continue to happen. And of particular importance, the extent to which adolescent substance use and other risky behaviors set the stage for adulthood difficulties will continue to be of concern; from this line of research will be a better understanding of what matters most during adolescence in the long run.

More broadly, a better integration of epidemiological and etiological perspectives on the problem of adolescent drug use can yield needed discoveries about the universality vs. specificity of trajectories and of mechanisms. These discoveries will advance both theory and intervention. We have learned, for example, that despite changes in levels of substance use across the past three decades, common risk and protective factors (many covered in this chapter) have generally remained invariant in their effects (Brown, Schulenberg, Bachman, O'Malley, & Johnston, 2001; Patrick & Schulenberg, 2010), suggesting some consistency in etiologic mechanisms and intervention targets. In contrast, there is new evidence that the course of substance use across the transition to adulthood has changed in important ways in recent years. Specifically, although high school alcohol and marijuana use has declined for recent cohorts compared to earlier cohorts, the subsequent rates of increase in use into the early 1920s have become faster for the recent cohorts (Jager, Schulenberg, O'Malley, & Bachman, 2013). This relatively more rapid escalation of substance use following high school raises numerous questions about shifts in etiologic mechanisms and intervention targets. Simply, the multilevel context in which development is embedded is also a moving target. Such insights can only come from integrating breadth and depth in our science, allowing us to gain empirical footholds on the grand and beautifully complex ecological (Bronfenbrenner, 1979), developmental-contextual (Lerner, 2006), and systems (Sameroff, 2010) frameworks of human development.

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