

# Student Factors: Understanding Individual Variation in College Drinking

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**ABSTRACT.** *Objective:* Research on individual differences in drinking rates and associated problems among college students is reviewed. *Method:* Studies are included if completed within U.S. college and university samples and found in published scientific literature as identified by several searches of national databases. *Results:* The resulting review suggests first that the extant literature is large and varied in quality, as most studies use questionnaire responses from samples of convenience in cross-sectional designs. Evidence from studies of college samples does consistently suggest that alcohol is consumed for several different purposes for different psychological effects in different contexts. A pattern of impulsivity/sensation seeking is strongly related to

increased drinking among students. This pattern is supported by research into personality, drinking motives, alcohol expectancies and drinking contexts. A second pattern of drinking associated with negative emotional states is also documented. Some long-term consequences of this second pattern have been described. Social processes appear especially important for drinking in many college venues and may contribute to individual differences in drinking more than enduring personality differences. *Conclusions:* Future research efforts should test interactive and mediating models of multiple risk factors and address developmental processes. (*J. Stud. Alcohol*, Supplement No. 14: 40-53, 2002)

**T**HIS REVIEW addresses individual variation in drinking among college students. The review is based on the observation that alcohol consumption is not uniformly extreme in the population. For example, in an analysis by Wechsler et al. (1999), the statistical average for consumption of alcohol in a week by a college student is about five standard drinks. Variability, however, is high. In the Wechsler et al. (1999) report, the top 17% of the sample (those students who drink heavily and frequently) consumed 68% of all alcohol drunk by college students. The 56% of students who do not drink heavily consumed only 9% of the total alcohol consumed. Which college students drink most and have the most problems as a result, and why do they do it? How do they differ from their moderate drinking or sober peers? The focus of this review is both to identify and understand this variability.

Variables that might account for this variability cover a wide range of biological, psychological and social factors, and this review will cover only a subset. In particular, other reviews in this series will address: the relationship between basic demographic variables and alcohol consumption, including age, gender and ethnicity (O'Malley and Johnston, this supplement); broad or distal aspects of the college environment, such as alcohol availability and pricing, adver-

tising, legal and university rules and regulations and enforcement (Toomey and Wagenaar, this supplement); and models of risk based on understanding of human development (Schulenberg and Maggs, this supplement). Reviewed herein are studies of stable individual characteristics in relation to drinking, including family history, genetics and human personality as well as psychological processes concerning the perceived effects of alcohol, motivation to drink, interpersonal (social and peer) relations and social norms. Studies concerning the impact of immediate or proximal college-specific social contexts and activities that students select (e.g., athletics or fraternities) are also addressed. It is noteworthy that social contexts and activities represent factors that influence drinking at both individual and social levels.

Studies are included if completed within U.S. college and university samples and found in published scientific literature as identified by several searches of national databases by searching both title and abstract for reference to *college* or *university*. No age requirements were imposed within the search; the vast majority of studies assess undergraduate students between the ages of 18 and 21. Studies published before 1985 generally are summarized based on a comprehensive review published in 1986 (Brennan et al., 1986a,b). Key or exemplary studies will be highlighted, rather than all studies catalogued. Following a commentary on methodological issues, the research literature with respect to college student drinking will be reviewed moving from micro to macro levels of effects and developmental

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course. Specifically, differences based on genetic and family history factors will be reviewed first, followed by research on aspects of personality. More psychological and potentially variable constructs of drinking motivation and alcohol expectancies are reviewed next, followed by research on social factors. In a concluding section, the results from this review will be considered relative to broader developmental models of alcohol-related problems etiology and future research agendas.

### **Methodological Considerations**

Many studies of individual variation in college drinking follow a similar format. Questionnaires measuring something about individual differences (e.g., aspects of personality) and self-report questionnaires about some aspects of drinking habits (e.g., frequency of drinking) are administered to a group of college students. Students are often taken from college classes (typically psychology courses) as convenient volunteers. Self-report questionnaire responses are then related to some aspect of drinking behavior. Although such studies do provide a starting point for future research, they can be quite limited with respect to interpretability and generalizability. A brief review of these methodological considerations is necessary before presentation of research findings.

First, student factors as indices for risk for drinking can be evaluated only with respect to some agreed-on standard for measuring drinking behavior. Unfortunately, the research literature is not consistent in how drinking is defined or measured among college students (Heck and Williams, 1995). To complicate matters further, the literature on adolescent drinking seems to suggest that different models of risk (relationships between individual differences and drinking behavior) may be found depending on how drinking is defined and measured (Baer et al., 1998). For this review, two classes of drinking measures are generally considered: drinking rates or levels (quantity and frequency of alcohol consumption) and drinking-related problems (negative consequences of drinking, including dependence and misuse diagnoses).

Second, design features often limit interpretations of observed relationships. Much of the research on college student populations uses measures that have not been developed carefully (or information on the quality of questionnaires simply is unavailable for the reader). Alternative explanations of results (e.g., the presence of third variables that account for relationships) are not often tested. Multiple measures of the same theoretical underlying constructs are rarely used to control for artifacts of measurement method. In addition, there are very few observational studies of college student drinking in relation to individual differences. Longitudinal designs are also quite exceptional. Without methodology to rule out many alternative explanations for

statistical relationships between the individual differences and drinking, causal interpretations generally cannot be made with confidence.

Third, the students who are actually involved in social-psychological research on college campuses pose an additional and key threat to the meaning and generalizability of much research on college drinking. As noted above, the typical study uses volunteers, often for extra credit in a psychology course. These "samples" of college students are used to study the "population" of college students. Yet volunteers from psychology classes may or may not be representative of all students. Thus the relationships observed in the study may not be true for other students. This is particularly important when the full range of an individual difference may not be present in the study sample (i.e., mild social anxiety, moderate anxiety in public speaking, severe anxiety resulting in clinical diagnosis). Very few studies of individual variation in college drinking attempt or succeed in generating samples of students that are documented to be representative of broader college populations.

Finally, statistical variation beyond that expected by chance (e.g., the accepted standards for "significant" findings) does not necessarily provide measures of the magnitude of differences observed. Many differences are described in social-psychological research that are simply too small to be used by policy-makers and prevention specialists to target programs and policies.

Despite this generally poor methodological quality in most studies, several consistent relationships have been observed. A few particularly well designed studies have been published in the past several years, and these will be described in more detail.

### **Family History and Parents' Behavior**

There has been great interest in the role of genetics and family history in the etiology of alcohol-related problems. However, relatively little research on the genetics of alcoholism has focused specifically on college students as a clinical population. Perhaps this is due to the fact that college students, on average, do not show signs of severe alcohol dependence even though a subset of students sometimes drink great quantities of alcohol. Further, research is at best mixed in documenting that college students with parents who have alcohol-related problems drink more or have more alcohol-related problems than their peers from nonalcoholic families. For example, Engs (1990) reported that rates of drinking were indistinguishable comparing college students who do and do not report a history of parental drinking problems. Alterman et al. (1989) and Havey and Dodd (1993) reported similar results (for a study of a female sample, see Bogart et al., 1995). Kushner and Sher (1993), in contrast, reported considerably higher rates of alcohol use disorders among Children of Alcoholics

(COAs) (35%) compared with non-COAs (16%) in a large sample of college students first assessed during their freshman year. Perkins and Berkowitz (1991) and Pullen (1994) also reported increased rates of alcohol-related problems for COAs compared with non-COAs. Rodney and Rodney (1996) found that black male COAs reported greater drinking than black non-COAs.

It is difficult to reconcile these disparate research findings. It is possible that larger samples are needed to detect relatively small COA effects (e.g., Alterman et al., 1989, studied less than 100 students); however, Eng's (1990) study was completed on a quite large sample of almost 1,000 students. Studies also vary in the way that family history is measured and defined. Studies that define family history quite conservatively (i.e., based on alcoholism treatment of parents) and rule out adoptive parents and stepparents to study genetic influence result in lower rates of COA membership and may be more likely to find different rates of drinking problems based on COA status (e.g., Kushner and Sher, 1993). Studies using broad assessments of family environment (Engs, 1990; Havey and Dodd, 1993) were among those failing to find COA effects. It is also possible that COAs do not necessarily drink at greater rates than other students (see Engs, 1990) but do report greater alcohol-related problems as a result (Kushner and Sher, 1993). Yet the self-report nature of studies of alcohol-related problems may limit confidence in results. Relative to non-COAs, COAs may be more willing to acknowledge or label behaviors as problems based on experiences growing up (George et al., 1999). For example, Pullen's (1994) study is based on Michigan Alcoholism Screening Test scores for students, which could be biased by Alcoholics Anonymous attendance for other family members. Given the somewhat select nature of populations of college students (i.e., college students must show promise in prior educational activities), it is also quite possible that those individuals with greatest risk for alcohol-related problems never enroll in the colleges where the research is conducted. Studies of COAs among college populations thus may include only the relatively successful COAs. This effect should be greatest within more elite institutions with highly competitive entrance requirements. In summary, although it appears likely that COAs within college populations may be at some increased risk for alcohol-related problems, the inconsistency of the research evidence suggests that it may be a smaller or more variable risk factor than when studied in other populations.

Independent of genetic risk, the behavior of parents, both generally and with respect to drinking, has been studied as a predictor of college drinking. Brennan et al. (1986b) reviewed 10 studies examining parental reports of drinking practices and students' reports of drinking practices. Eight of these studies showed positive but small effects, suggesting that drinking among college students was associated

with increased drinking by their parents. Studies were inconsistent with respect to gender differences, with some suggesting the effect was stronger among men and some studies suggesting the effect was stronger among women. All studies were based on student perceptions of parental behavior, which could easily be confounded by the students' own drinking practices and perceived norms for drinking.

It is possible that problems with generalized parenting skills, not restricted to parental alcohol use, are associated with college students' adjustment, which then indirectly affects alcohol use; this indirect relationship has been described in research on adolescent alcohol use (see Baumrind, 1991; Colder and Chassin, 1992). Among college students, MacDonald et al. (1991) reported that a family history of depression was predictive of alcohol misuse, but not a family history of drinking problems. Weiss and Schwartz (1996) tested Baumrind's framework for effective parenting with college students and documented that more poorly adjusted college students, including those using substances, more commonly had unengaged and authoritarian-directive parents. There is some suggestion that the relationship between parent and college student drinking exists only when the parent-child relationship is experienced as close (Jung, 1995) or the students perceive themselves as similar to the parent (Fromme and Ruela, 1994).

### Personality

Studies of student personality are among the most common with respect to alcohol use. Personality typically refers to characteristic ways of thinking, feeling and acting that show some consistency when measured across situations and over time. Research on personality and alcohol use and misuse here is organized based on three, broad-based personality constructs: impulsivity/disinhibition, extraversion/sociability and neuroticism/emotionality (Sher and Trull, 1994; Sher et al., 1999).

#### *Impulsivity/disinhibition*

One of the most consistent findings in Brennan et al.'s (1986a) review, demonstrated in 20 studies, was that a general personality dimension described as "impulse expression/sensation seeking" was associated with drinking more frequently, in greater quantities and with more negative consequences among college students. In these early studies, heavier drinkers were described as pleasure seeking, extraverted, impulsive, rebellious and nonconforming. This relationship appeared true for both men and women and for studies of observed behavior as well as self-report. Several studies in the Brennan et al. (1986a) review also documented that heavier drinkers consistently endorsed attitudes that were permissive of heavy drinking.

Since 1985, this relationship between a personality style of sensation seeking, disinhibition and nonconformity has been replicated consistently. College students described as impulsive (Camatta and Nagoshi, 1995) and disinhibited (Clapper et al., 1994); scoring higher on Minnesota Multiphasic Personality Inventory (MMPI) scales of Psychopathic Deviate and Hypomania (Valliant and Scanlan, 1996); with a history of deviant behavior (MacDonald et al., 1991), sensation seeking (Arnett, 1996; Johnson, 1989) and nonconforming (Havey and Dodd, 1993) drink more heavily and more frequently than other students. Students with a history of deviant conduct not only drink more before entering college, but increase their drinking rates to a greater degree on college entry (Baer et al., 1995). One study documented a relationship between anger and drinking problems as well (Leibsohn et al., 1994).

Nonconformity and deviance can also be implied by use of multiple substances and early life initiation of alcohol consumption. College students who report using marijuana and cigarettes are more likely to drink heavily (Wechsler et al., 1995). That heavy drinking does not always begin in college has now become firmly established. Gonzalez (1989) reported that only 7% of university students in Florida began drinking in college. This estimate is consistent with national studies of alcohol initiation, which typically begins in teenage years, before college (Johnston et al., 1995). In Gonzalez' (1989) study, students who began drinking earlier in life, particularly beginning in elementary or middle school, reported higher levels of drinking and greater alcohol-related problems than those who began in high school or college. This pattern has been noted in a study of a historically black college (Lo and Globetti, 1993). Clapper et al. (1994) further demonstrated that early onset of drinking was associated with rates of drinking among first-year college students even when personality and peer use variables were controlled. Wechsler et al. (1995), in their study of 140 campuses, found that the frequency of heavy episodic drinking in high school was predictive of the frequency of heavy episodic drinking in college when controlling for a variety of other individual difference measures.

The construct of sensation seeking and impulse expression and nonconformity encompasses a variety of trait adjectives and behavioral tendencies as noted above. Research to date has not demonstrated that particular or specific aspects of this general concept are more risky or important in the prediction of heavy drinking and problems than other aspects. Specific aspects of this general construct could represent noise or error in assessment of the general construct. At least one study (Earleywine et al., 1990) found that the relationship between measures of personality risk for drinking (California Psychological Inventory Socialization scale and MMPI MacAndrew scale) and self-reported drinking practices among college students was greatly increased when

the personality measures were treated as indicators of a single underlying construct. Based on this analysis, fluctuating relationships between measures of personality traits relevant to impulse control and measures of drinking could be due to unreliable assessment. On the other hand, it is noteworthy that the Disinhibition subscale of Zuckerman's Sensation Seeking Scale, which has been used frequently in this research, does contain items that specifically ask about alcohol use. A careful analysis of this scale, using college students as subjects, suggests that relationships between drinking and disinhibition could be exaggerated (Darkes et al., 1998).

*Religiosity/conventionality.* Consistent with research indicating that students who are more rebellious and less conforming to traditional values drink more, several studies show that students who are more religious and more committed to traditional values drink less. For example, the reasons students give for limiting their drinking have been characterized as reflecting their upbringing, performance, self-control and self-reform (Greenfield et al., 1989). In Wechsler et al.'s (1995) report on surveys of 140 colleges, the belief that "religion is important" was significantly and independently related to reduced frequency of heavy drinking. Engs et al. (1996) similarly noted that students who endorsed a questionnaire response that "religion was not important" drank more heavily and reported a greater incidence of drinking problems compared with others. In a survey of 264 college students, Patock-Peckham et al. (1998) showed that students with no religious affiliation drank more frequently and at a higher quantity but did not have greater problems than those with religious affiliations. Lack of religious affiliation was also associated with higher perceived drinking norms in this study. Lo and Globetti (1993) documented this relationship among students of a historically black college, and Poulson et al. (1998) documented a similar relationship, but only among southern women college students. Perkins (1994) also suggested that religiosity may protect against heavy drinking under contexts of greater ambiguity about drinking (less constraint). In this data set, the relationship between religiosity and drinking was greatest among men at periods of more permissive norms and when men perceived norms as more permissive.

#### *Extraversion/sociability*

The personality dimension of extraversion/sociability has also been investigated as an individual difference predictive of drinking in college students. Students rated as extraverted (Martsh and Miller, 1997) and those who rate parties as important (Wechsler et al., 1995) have been shown to drink more than other students. This relationship may be particularly relevant within college populations compared with both younger and older samples. Research examining

this relationship in noncollege populations is mixed (Wood et al., 2001). As reviewed by Wiggins and Wiggins (1992), some studies find relationships between sociability and drinking that are positive but weak, and many do not find the relationship at all. Nezlek et al. (1994), however, argued that even among college samples the relationship between drinking and sociability is likely quite complex. By analyzing daily logs of drinking and social activities of college students, Nezlek et al. suggested that the greatest intimacy was experienced by students who drank heavily occasionally. Those who did not drink reported less intimacy and less self-disclosure, and men who drank heavily frequently rated their interactions as less intimate than any other group of men or women. Nezlek et al. suggested that students who have some heavy drinking experiences (but not a great deal) appear most integrated into the college community. Thus extraversion/sociability may be related to drinking rates among college students, but less related to drinking problems. More research is needed to better specify the nature of this relationship.

#### *Neuroticism/emotionality*

The Brennan et al. (1986a) review also revealed mixed support for a relationship between drinking patterns of college students and anxiety, depression and other indices of emotional distress. Two studies were noted to find positive, but weak relationships between high neuroticism scores and frequency of drinking, but not quantity. Two different studies found relationships between extremely high scores on trait anxiety and negative consequences of drinking. These relationships were typically greater among female college students than among male college students. However, at least two studies reported the inverse relationship—that individuals who drank more frequently experienced less anxiety than those who drink less frequently. Brennan et al. (1986a) documented four studies showing a relationship between variables such as loneliness, frustration, depression and boredom and drinking frequency, quantity and consequences among female college students but not male college students.

More recently, Camatta and Nagoshi (1995) reported a positive correlation between stress, depression, “irrational” beliefs (thought to be a hallmark of depression) and alcohol-related problems. Regression analyses further suggested that the depression mediated the relationship between stress and alcohol-related problems. Although this study was limited by the convenience nature of the sample, and the fact that the sample was not balanced across gender, the multivariate analyses included measures of impulsiveness and venturesomeness, thus testing a model with both primary dimensions of personality present. Pullen (1994) also reported depression and state anxiety as predictors of drinking problems. Comorbidity between alcohol misuse

and depressive disorder was noted by Deykin et al. (1987) in a study of 424 college students. Based on retrospective self-report, the onset of depression was reported to precede the onset of alcohol misuse.

Alcohol may also be used to manage anxiety. Kushner and Sher (1993) documented increased comorbidity between anxiety and alcohol diagnoses. In this study, alcohol diagnoses were almost twice as likely among those with anxiety disorder compared with those without. This finding is particularly strong given that the research sample was selected as representative of students (not convenience) and that a diagnostic interview was used to assess anxiety disorders. Kushner et al. (1999) followed up with a longitudinal analysis after the same sample had been followed for 7 years. Results suggested reciprocal causal relationships over time. Having an anxiety disorder at either Year 1 or Year 4 significantly increased the likelihood of an alcohol disorder in Year 7. Similarly, the presence of an alcohol disorder in Year 1 or Year 4 significantly increased the likelihood of anxiety disorder in Year 7. It is noteworthy that this relationship may be specific to higher levels of anxiety (levels that result in clinical diagnoses). As noted above, studies are mixed with respect to moderate levels of social anxiety predicting alcohol use (Brennan et al., 1986a).

In the Brennan et al. (1986a) review, five studies documented a relationship between frequency and problems of drinking and lower self-esteem, although one study specifically tested for this relationship and did not find it (Ratliff and Burkhart, 1984). In the Brennan et al. (1986a) review, there was some suggestion that the relationship between self-esteem and drinking was stronger among females than males. More recent research by Corbin et al. (1996) replicated the relationship between increased drinking and lower self-esteem only among females. Walitzer and Sher (1996) followed this line of research with the same sample of college students noted above who were assessed annually over 4 years of college. Walitzer and Sher found that low self-esteem at baseline prospectively predicted alcohol use disorders at 3- and 4-year follow-up among women only. It is noteworthy that Walitzer and Sher tested and ruled out the reverse effect, that heavy drinking or drinking problems creates low self-esteem. The prospective and multivariate nature of the Walitzer and Sher study lends considerable confidence in the observed relationships. It is also noteworthy that alcohol-related problem diagnoses represent a more stringent test of a relationship between self-esteem and drinking problems than most studies that examine only drinking rates.

#### **Drinking Motives, Alcohol Expectancies and Perceived Norms**

A considerable amount of research has investigated cognitive factors in the prediction of individual differences in

drinking rates and associated problems. Drinking motives refers to the need or psychological function that alcohol consumption fulfills and are typically assessed by responses of students to questionnaires about their reasons for drinking. Different motives for drinking are thought to relate to primary psychological effects that are experienced with the consumption of alcohol. A related concept is that of alcohol expectancies, defined as specific beliefs about the behavioral, emotional and cognitive effects of alcohol. Alcohol expectancies are also typically assessed by questionnaires, which ask respondents to rate the likelihood and/or value of specific behaviors or feelings thought to occur with alcohol consumption. Perceived norms refer to ratings students make about the acceptability and typicality of various drinking behaviors. In essence, the assessment of perceived norms is an attempt to measure students' understanding of the social support and acceptance of drinking practices.

### *Drinking motives*

Brennan et al. (1986a) identified eight studies examining different motives for alcohol consumption among college students. Two general types of drinking motives typically emerge in studies of college students: drinking for social purposes and drinking for emotional escape or relief. In the Brennan et al. (1986a) review, five studies associated escape motives with increased drinking and related problems among college students. However, at least one study documented increased frequency of intoxication associated with motives to drink for "getting drunk" (Wechsler and Rohman, 1981).

More recent research suggests that both classes of motives are likely important, perhaps for different individuals for different types of outcomes. Haden and Edmundson (1991) reported that, in contrast to predictions of other drug use, alcohol use rates were better predicted by social motivation than by personal motivation (although both motivations were significant predictors of drinking within a regression model). Bradley et al. (1992) similarly reported that positive social motives were related to alcohol-related negative consequences, in addition to negative personal motives. A study by Billingham et al. (1993) suggests the presence of gender differences in the function of drinking motivations. Billingham et al. found more reasons for drinking that actually related to drinking categories (moderate versus heavy) for women than for men. For women, factors such as "drink to get drunk," "forget disappointments," "feel good" and "get along better on dates" all contributed to a multivariate discriminate analysis. For men, fewer factors emerged, and one, "drinking to get drunk," accounted for most of the multivariate prediction.

Cronin (1997) developed a "reasons for drinking" scale with three primary dimensions: social camaraderie, mood enhancement and tension reduction. Social camaraderie en-

tered first in regression models predicting drinking rates, but mood enhancement entered first in prediction of alcohol-related problems. In most models, all three motivations demonstrated unique predictive potential. Finally, Carey and Correia (1997) sought to use drinking motivations to understand the relationship between drinking rates and drinking-related problems among college students. Carey and Correia found that negative reinforcement motives accounted for variance in alcohol-related problems beyond that accounted for by drinking rates. Positive reinforcement motives did not significantly contribute to the multivariate analysis. The authors concluded, based on additional analyses, that both positive and negative reinforcement motives contribute both indirectly and directly to account for drinking problems. Gender did not interact with these effects.

It is noteworthy that none of the studies just described pertaining to drinking motives were longitudinal in design, and all used samples of convenience. Thus the generality and the potential causal nature of relationships between drinking motives and drinking rates and problems remain to be demonstrated. One recent longitudinal study is an exception, however. Perkins (1999) reported that stress-motivated drinking became relatively (to other motivations) more prevalent after college graduation, and at this later time is associated with increased drinking rates. Interestingly, this relationship appears sooner after college graduation for women than for men.

### *Alcohol expectancies*

In the last 10 years there has been considerable interest in how alcohol expectancies relate to the use and risks associated with drinking. It is thought that the cognitive representation of the effects of alcohol affects decisions and motivations to drink and may reveal more problematic or risky patterns of use. Considerable research has taken place with college students. Brown (1985) showed that alcohol expectancies yielded better predictive capacity for college drinking than did demographic variables. Further, social drinkers were shown to expect social enhancement from alcohol, whereas problem drinkers were more likely to expect tension reduction from alcohol. Thus alcohol expectancies not only increased the predictability of college drinking, but were differentially related to problematic and nonproblematic patterns of college drinking as well. Other studies using college samples and different methodologies found that heavier drinkers report more positive effects over all dimensions than lighter drinkers (Leigh, 1987; see also Bogart et al., 1995). Leigh and Stacy (1993) similarly reported that positive expectancy was a stronger predictor of rates of drinking than was negative expectancy. Werner et al. (1995) reported that heavier drinkers expected more positive effects on sociability and sexuality and expected less effects on cognitive and behavioral impairment. These

results are consistent with studies of expectancies that use a free recall method as opposed to questionnaires. To control for potential biases in forced-choice questionnaires, Wood et al. (1996) asked students to generate their own beliefs about expected alcohol effects. Subjective ratings of positivity of alcohol effects were related to drinking rates, but not problems. Importantly, the absolute number of expectancies listed by students was correlated with alcohol dependence symptoms. This finding is consistent with Stacy et al.'s (1994) suggestion that frequent experiences with alcohol influence the accessibility of thoughts about alcohol use and expected outcomes.

To test for possible causal relationships between alcohol use and beliefs about alcohol effects, there have been several recent attempts to use measures of expectancies to predict drinking among college students over time. In a study of 184 students who completed measures of drinking and expectancies during the freshman and junior years, Werner et al. (1995) reported that high-risk drinkers had the greatest positive expectations for alcohol effects at both time points. Participants who moved into a problem-drinking category had higher positive expectancies at both time points and developed less concern for negative outcomes over time. Carey (1995a) also used a brief prospective design, assessing drinking at 1-month intervals, and found that global positive expectancies prospectively predicted maximum daily quantity of drinking and that expectancies for sexual enhancement prospectively predicted frequency of drinking. Kidorf et al. (1995) studied alcohol expectancies in a prospective design over a 2-month period. Prospective prediction of beer consumption was found for expectancies of increased social assertiveness and global positive changes, but only among men.

Perhaps the most comprehensive prospective study of expectancies and college drinking as of this writing is that of Sher et al. (1996). In this sample, 458 college students, half of whom were COAs, were assessed annually over 4 years, beginning as college freshman. Four subscales of outcome expectancies were assessed (Tension Reduction, Social Lubrication, Activity Enhancement and Performance Enhancement) and used to measure a general construct of the strength of alcohol outcome expectancies. Drinking rates were assessed annually as well, using four measures of drinking quantity and frequency. Results suggested first that COAs report higher alcohol expectancies on all four scales and that expectancies generally decrease over 4 years of college. Prospective prediction of drinking rates from alcohol expectancies was demonstrated over the 4-year interval. This carefully conducted study also showed that the prospective prediction was generally invariant across COA status and gender.

Although the most consistent relationships have been found for global positive expectations, some specific expectancies have been linked to specific individuals. For ex-

ample, Mooney and Corcoran (1989), in a cross-sectional design, reported that expectancies for social assertion were associated with drinking rates only for those low in assertiveness. Several studies, typically with cross-sectional designs, have also sought to evaluate expectancies within broader matrices of predictive factors for college drinking. Wood et al. (1992) failed to find interactive effects between expectancies and perceived norms and reasons for drinking in the prediction of drinking. Cronin (1997), also using a cross-sectional design, demonstrated that reasons for drinking (motives) accounted for more variance in alcohol use measures than did expectancies for alcohol effects.

### *Perceived norms*

In the last several years, there has been considerable attention to social norms for alcohol use on college campuses. Following data indicating that peer use is a powerful predictor of individual use rates, and that heavy drinkers hold attitudes more accepting of heavy drinking, Perkins and Berkowitz (1986) noted that students, despite holding moderate attitudes about heavy drinking themselves, perceived the community norm of alcohol use as much more liberal than their own. This pattern of "pluralistic ignorance" was replicated by Prentice and Miller (1996), documenting that Princeton students perceived the average student to be more comfortable with campus drinking practices than they themselves were. Baer and colleagues (Baer and Carney, 1993; Baer et al., 1991) showed that students believed that normative drinking rates and drinking consequences not only were higher than their own, but higher than they actually were when measured independently. This discrepancy has been documented in ratings of alcohol and other substance use in a large multicollge sample (Perkins et al., 1999).

There is some evidence that normative perceptions are an individual risk factor for heavy drinking; that is, that higher perceived norms are associated with higher levels of drinking and problems (Perkins and Wechsler, 1996; Thombs et al., 1997; Wood et al., 1992). Not all studies document this relationship, including one specifically designed to test it (Baer and Carney, 1993). One study (Wood et al., 1992) showed that perceived social norms for drinking were independently related to drinking rates but not drinking-related problems, when tested within a multivariate model that included measures of drinking motives and alcohol expectancies. Perkins and Wechsler (1996) reported that perceived norms for alcohol use predicted alcohol misuse most strongly among students who also endorsed liberal attitudes about drinking. Thus perceived norms for drinking may justify or exacerbate heavy drinking only under conditions where more accepting social attitudes already exist. Research is needed to continue to refine the

measurement of perceptions of drinking norms and to better understand what social and individual factors lead to their development. Continued research is needed to document that perceived norms independently predict heavy and risky drinking with longitudinal designs.

### **Social Affiliation**

Peer use is perhaps the strongest predictor of adolescent alcohol use (Bucholz, 1990; Jacob and Leonard, 1994). The college years are commonly marked by social activity, and much of the alcohol used on college campuses is consumed at small and large parties. Thus research into individual differences in drinking on college campuses has begun to focus on both the assessment and prediction of social activities in understanding drinking behavior. It is noteworthy that the study of social activities necessarily combines studies of factors at the individual level (i.e., the social organizations that students select and maintain) and factors that exist at a more social level (i.e., the effects of social organizations on their participants).

#### *Social context*

*Social context* is a term that is used to attempt to characterize social and psychological environments where drinking takes place, and in so doing attempt to measure the interaction of interpersonal, temporal and situation factors (Thombs et al., 1997). Social contexts for drinking naturally vary with respect to participants' age, gender, living situation, work and so on and thus hold promise for capturing differences and similarities in drinking practices in specific venues like college campuses.

Drinking contexts can be described without psychological features, but simply by the size and the composition of participants. Rosenbluth et al. (1978), for example, reported that larger drinking groups were associated with greater consumption of alcohol. Perkins and Berkowitz (1986) also noted this pattern. More recently, Senchak et al. (1998) evaluated social contexts of drinking with respect to the size and gender makeup of social drinking events on college campuses. Both group size and gender differences were observed. Men reported greater frequency of drunkenness in large groups of mixed sex and small groups of same sex individuals compared with small mixed sex groups. Women's frequency of drunkenness was unrelated to gender mix or group size. It appears that women's presence in small groups may moderate male consumption. It is noteworthy in this study that men and women who reported drinking in large mixed sex groups were less depressed and less socially avoidant than those who preferred small groups, although depression and social avoidance did not account for differences in drinking in different social contexts. Differences in drinking as a function of context also

could not be accounted for by alcohol expectancies or measures of masculinity/femininity or youthful deviance.

Several researchers have recently sought to go beyond the assessment of drinking context size and composition and assess psychological and social factors present in drinking contexts. At least two different measures have been developed to assess drinking contexts specifically among college students. Thombs and Beck (1994) developed a Social Context of Drinking Scale with subscales assessing Social Facilitation, Emotional Pain, Peer Acceptance, Family, Sex Seeking and Motor Vehicle. O'Hare (1997) developed a 23-item Drinking Context Scale, with three subfactors assessing Convivial Drinking, Private Intimate Drinking and Negative Coping. Thombs et al. (1997) reported that the drinking context of social facilitation was strongly associated with a measure of drinking intensity. Contexts of sex seeking and emotional pain also contributed to multivariate prediction. Beck et al. (1995) showed that drinking for social facilitation and disinhibition were important discriminators between higher and lower intensity drinkers in both genders. However, for women, drinking in the context of emotional pain further discriminated between higher and lower intensity drinkers. Perhaps due to conceptual proximity to actual drinking behavior, drinking context scales for college students have been shown to be better predictors of drinking than are measures of personality (Beck et al., 1995) and alcohol expectancies (Thombs et al., 1993).

Carey (1993) reported that contexts for college drinking are specific rather than general. Carey showed that heavy drinkers in a college sample differed from moderate drinkers in their ratings of the frequency of drinking in four of eight types of drinking situations. The situations that did differentiate between the groups were social pressure to drink, pleasant times, pleasant emotions and physical discomfort. Carey (1995b) replicated and extended this line of research, showing that situation ratings were associated with drinking problems as well as rates. It is noteworthy that Carey (1995b) observed no gender differences in the relationship between situation ratings and drinking problems.

#### *Activities and organizations*

Several studies have examined variation in student drinking as a function of the types of activities and organizations in which students participate. Some of these activities are quite public and highly visible (e.g., athletics) and thus attract a fair amount of attention from administrators. Where students live also affects drinking. Students living at home with parents tend to drink less (Valliant and Scanlan, 1996). Residence in dormitories has also been associated with increased drinking in larger population studies (Barnes et al., 1992; Gfroerer et al., 1997).

There are strong data suggesting that members of Greek social organizations, fraternities and sororities drink more



heavily and more frequently than other students (Cashin et al., 1998; Engs et al., 1996; Wechsler et al., 1995). In the Cashin et al. (1998) study of more than 25,000 students from 61 institutions, students affiliated with Greek system organizations reported greater frequency of drinking, greater quantity of drinking and more negative consequences related to use compared with students not affiliated with Greek organizations. Members of Greek organizations felt that alcohol was a vehicle for friendship, social activity and sexuality in greater numbers than did comparison nonmembers. Further, the leadership within Greek organizations drank as much or more than did average members, suggesting that leadership may set heavy drinking norms. Indeed, some studies of biased perceptions of behavioral norms were conducted among members of Greek houses (Baer and Carney, 1993; Baer et al., 1991). Fraternities also appear to accept higher levels of drinking as normal (Baer, 1994). Fraternity membership is associated with initiation of drinking among that subset of students who do not already drink on entry into college (Lo and Globetti, 1993). In Wechsler et al.'s (1995) study, membership in a fraternity was the strongest predictor of the frequency of heavy drinking in a final logistic regression of 18 risk factors. It is noteworthy that studies of Engs et al. (1996), Cashin et al. (1998) and Wechsler et al. (1995) all involve questionnaire data from multiple colleges, thus increasing confidence of the generalizability of the finding. Finally, Sher et al. (2001) have recently shown with their longitudinal study that heavy drinking associated with membership in fraternities and sororities does not persist in the years after college. Given the time-limited nature of drinking in these social organizations, and controlling for individual drinking levels when entering the social organizations, led Sher et al. (2001) to argue that social normative processes appear critical for students in these contexts.

Data from two different multicampus data sets also suggest that college students involved in athletics drink more frequently than other students. Based on the Core Survey, Lechlitter et al. (1998) reported on responses of more than 50,000 students from 125 institutions. Both male and female college students who were also athletes drank more heavily, drank more frequently and reported more negative consequences from drinking compared with nonathletes. Lechlitter et al. further found that male leaders of athletic teams drank at a rate higher than that of other team members. In the Wechsler et al. (1995) study of 140 colleges, response to the item "athletics are important" was associated with increased rates of heavy drinking, even when controlling for other risk factors.

It is noteworthy that, although members of athletic and Greek organizations have been shown to drink more than other students, little is known about how members of these organizations differ from other students on other dimensions. Heavy drinking is not found uniformly in all Greek

organizations; students in some organizations drink considerably more than students in other organizations (Harrington et al., 1997). Leibsohn (1994) noted, for example, that students entering college selected friends who drank in a similar manner. There is some evidence that high school students who plan to join fraternities drink more than their peers who do not plan to join (Baer et al., 1995). Yet in this same study the drinking of fraternity members increased more than did the drinking of others on entry to college. It is likely that drinking is influenced both by selection of social organizations and by socialization within organizations. Sher et al.'s (2001) recent study suggests that heavy drinking occurs in Greek houses independent of selection processes and provides some hope that such heavy drinking is limited to the time period in college when social norms for drinking are elevated.

### *Drinking games*

Researchers have recently begun to study a specific social interaction common on college campuses, the "drinking game." Drinking games involve a set of rules that typically define when and how much participants must drink. Most rules are designed to ensure large consumption of alcohol (Newman et al., 1991). Participants in such games report increased levels of drinking and drinking-related problems compared with nonparticipants (Engs and Hansen, 1993; Wood et al., 1992). Yet, in one descriptive study, once general alcohol use rates are controlled, game playing did not contribute to the prediction of alcohol-related problems (Nagoshi et al., 1994). Nagoshi et al. found that game participation was related to celebratory reasons for drinking, use of marijuana and impulsivity. Johnson et al. (1998), via questionnaires completed by college undergraduates, reported that greater frequency of play was associated with lower social anxiety. Alcohol expectancies were not found to moderate this relationship. In a follow-up study, Johnson et al. (1999) developed an assessment of specific reasons for game playing and found that game playing was associated with a desire for celebration and a desire to meet potential sexual partners.

### **Summary and Commentary**

The goal of this review was to examine research on individual factors in relation to alcohol consumption among college students. Research before 1985 was summarized in a comprehensive review published in 1986 (Brennan et al., 1986a,b), which creates a natural point of reference. Initial pre-1986 research into individual differences in college student drinking focused on traditional aspects of personality to explain why some students drink more than others. Drinking motives were examined as a way of understanding different needs that alcohol might fulfill. Few multivariate

hypotheses were tested. In general terms, a pattern of behavior characterized by sensation seeking, impulsivity and nonconventionality consistently related to increased drinking. There was also evidence of a smaller factor of stress and affect relief drinking among college students, although studies are more mixed in support of this dimension. Drinking for stress and relief of negative affect was more consistently noted among females. Early studies of drinking motives tended to suggest that personal, emotion-coping motives were more strongly related to problems with alcohol than were social motives for drinking. Membership in Greek social organizations and social activities in large groups were associated with increased drinking.

Research since 1985 is highly variable in quality; many studies still rely on questionnaires at one point in time and ignore multivariate models of risk of alcohol-related problems, whereas other studies have become somewhat more sophisticated. Several recent reports assess multiple dimensions of drinking behavior and test multivariate relationships. In the last 15 years, new dimensions of individual differences have been developed and assessed, including expectancies of alcohol effects, better measures of drinking motivation, assessment of perceived norms for drinking and assessment of drinking contexts. It has now become the norm to assess both drinking rates and drinking problems. Further, there are now at least three large, cross-institution data sets that can address student factors (Meilman et al., 1998). Relationships documented with these data sets lend considerably more confidence to results than those found with studies from single institutions and based on samples of convenience. Perhaps most importantly, recently a few well-designed longitudinal studies have been completed that better address causal inferences (albeit most of the longitudinal studies are from one data set in Missouri).

It is noteworthy, of course, that even large, multicampus data sets can be biased based on who tends to complete questionnaires at various institutions. Even recent large studies of college students do not attempt nor document representative sampling across different demographic and social dimensions of college populations (Meilman et al., 1998). Thus what we know about student factors and drinking for the most part is limited to those who complete questionnaires. Studies of representative samples of college populations remain sorely needed.

Results of research conducted in the past 15 years are consistent with those that came earlier. For example, results from personality research showing a strong relationship between impulsivity and drinking are supported by research on drinking motives and drinking expectancies, as well as drinking contexts. An impulsive/sensation-seeking style seems manifest in the reporting of positive social motives, expecting greater positive effects from alcohol and participating in drinking games. Research has not yet directly linked personality dimensions of sensation seeking/

impulsivity to specific drinking motives, expectancies and game playing, but some evidence provides linkage, and the confluence seems likely. A second general pattern of drinking, one that is associated with stress and emotional coping, also is supported by research on drinking motives, expectancies, self-esteem and drinking contexts. Furthermore, anxiety disorders have been shown to be comorbid with alcohol disorders among college students, from both cross-sectional and longitudinal designs. This pattern of drinking likely constitutes a relatively smaller proportion of college drinking than that associated with socializing and impulsivity, but should not be overlooked. At least one longitudinal study has demonstrated prospective reciprocal relationships between alcohol diagnoses and anxiety diagnoses years after college. Thus alcohol use associated with managing anxious affective states may contribute to long-standing adjustment problems. Longitudinal relationships with drinking have not been demonstrated with more common and socially based motives for drinking.

Research further suggests that sociability and extraversion may have a specific role in the etiology of drinking within the college context. This is noteworthy because sociability does not consistently relate to drinking problems in other, noncollege populations (Sher and Trull, 1994; Wood et al., 2001). Data showing the strong effects of social organizations on drinking, as well as personality assessment, suggest this conclusion. Sociability and extraversion may also at least partially explain why college students, temporarily, drink more than their noncollege peers (Schulenberg et al., 2001).

The consistent assessment of both drinking rates and drinking problems has not, to date, revealed simple conclusions about differences in the prediction of rates and problems. In summary, both impulsive/sensation-seeking type drinking and stress/anxiety-based drinking are associated with both increased drinking rates and increased negative consequences. There is some evidence that stress/anxiety-based drinking is associated with long-term and more severe negative outcomes. Yet even highly social drinking results in negative consequences for college students. Future research should examine if different drinking motives result in different types of drinking problems. Such research necessitates the development of assessment techniques that can reliably differentiate among various negative consequences experienced within college contexts.

It is tempting to call for more multivariate research that tests theoretical and mediation models among the array of etiologic factors reviewed above. The dimensions or levels of individual variation reviewed above may interrelate in complex ways. For example, social contexts that students select or are exposed to may have powerful effects on attitudes and on drinking behavior. Dimensions of personality, such as a tendency toward sensation seeking, may relate not only to drinking but to the choice of drinking partners

as well. Research that integrates these various levels of influence and dimensions of behavior is needed. Further, multivariate models should also be developed and interpreted in combination with other broader social factors reviewed elsewhere. For example, it may be that students who reside in certain microsocial settings (i.e., fraternities) or individuals characterized by a certain personality style (i.e., sensation seekers) are least affected by broader social factors (i.e., price and availability constraints).

Some of this research has already begun. In the last 15 years, several researchers have begun testing multivariate or interactive models of individual differences among college students, for example, by examining demographic factors, drinking motives, expectancies and personality simultaneously and statistically controlling for multiple effects. Some intriguing interactive effects have been noted in the literature. For example, religiosity may be more protective against heavy drinking when or where social mores are most ambiguous (Perkins, 1994). Multivariate research also has addressed the uniqueness of factors being studied, for example, by showing that motives are to some extent distinct from expectancies.

To date, however, multivariate research efforts have for the most part not produced evidence of powerful interaction or mediation among constructs. Most multivariate research reviewed above tends to show that when various theoretical predictive factors are tested simultaneously, each carries unique predictive capacity (Bradley et al., 1992; Clapper et al., 1994; Cronin, 1997; Engs et al., 1996; Evans and Dunn, 1995; MacDonald et al., 1991; Pullen, 1994; Thombs et al., 1997; Wechsler et al., 1995; Wood et al., 1992). Although such results could be artifactual based on sampling and the nature of questionnaires, it is also likely that each of the "explanatory" factors contributes to the prediction of heavy drinking, but is not a simple or central predictive factor in and of itself. Strong models of mediation have not to date been supported in the literature with college students.

Future research efforts on student factors also should attend to developmental models of drinking as a method to specify dependent measures. In particular, Zucker and colleagues (Zucker, 1987, 1994; Zucker et al., 1995), in proposing a multivariate and integrative model of alcoholism risk, suggested that different types of "alcoholisms" are associated with different etiologic processes. Three central types of developmental paths are proposed to account for common courses. The first, "sociopathic alcoholism," is characterized by early onset, high sociopathy, criminality and high severity of drinking problems. This pattern of drinking problems may be strongly genetically influenced and associated with personality patterns of impulsivity and sensation seeking, begin early and follow a chronic course. A second pattern of "developmentally limited" alcohol-related problems is also proposed, consistent with epide-

miological data showing that heavy drinking in adolescents is associated with other delinquent behavior, but is commonly limited in time, diminishing significantly on the transition to young adulthood. This second pattern is likely associated with impulsivity (to a lesser degree than the sociopathic type) as well as extraversion. "Negative affect alcoholism," alcohol-related problems related to depressive and anxious symptomatology, is a third developmental path. It is thought to begin later in life, develop more slowly and be less associated with adolescence in general and delinquent behavior in specific. Zucker et al. (1995) suggested that in each case environmental processes (stress, lack of essential parenting, availability of alcohol) and/or biological processes (temperament, physiologic sensitivity) facilitate the development of problems (see also Tarter and Vanyukov, 1994).

Taken as a whole, the research literature with college students suggests that the first developmental trajectory (sociopathic) may not be common on college campuses. The key endpoints, high levels of dependence and high criminality, do not appear as dependent measures in the college drinking literature. Genetic effects, although likely present in college populations, may be limited in magnitude, and the chronicity and severity of drinking problems associated with sociopathic trajectories are not documented. It is likely that many of these individuals never achieve college entrance. Thus a search for the individual with severe alcohol-related problems and high sociopathy among current college students will be generally unsuccessful and will miss much of the problematic drinking that does exist.

In contrast, the second pattern of developmentally limited alcohol-related problems may account for much of the drinking found on college campuses. Relationships between drinking and impulsive expression, deviance, alcohol expectancies and drinking contexts support this conclusion. That college drinking is associated with sociability and extraversion also fits well within a model of developmentally limited alcohol-related problems. A developmentally limited model of college drinking is also consistent with data documenting that heavy drinking does not generally persist into postcollege roles (Donovan et al., 1983; Jessor et al., 1991).

Negative affect alcoholism, alcohol-related problems related to depressive and anxious symptomatology, also appears to be represented in college samples and, although less common, may carry greater risk for chronic problems over the long term. There is some albeit inconsistent evidence that drinking motives associated with management of negative affect are associated with greater problems. Longitudinal studies also document reciprocal prediction of anxiety diagnoses and alcohol diagnoses.

As just described, the now large literature on the etiology of drinking problems can be conceptually summarized by examining covariation in several risk factors and by as-

sessing patterns of change over time. It is likely that the population of college drinkers represent several different patterns of drinking with different developmental trajectories. The research on college student drinking too often examines only one point in time and thus does not relate research findings to possible developmental processes. Some central issues remain unexplored. For example, is variability in college drinking time limited or enduring over years? For whom? What constellation of etiologic factors predicts different patterns of drinking over time? What types of settings constrain drinking for what types of students? Through what kinds of social influence processes? A better understanding of the processes that lead to problems for certain individuals in certain settings will develop through exploration of these questions. Further, with an understanding of risk factors in contexts, administrators and health professionals will be better able to identify and reach those most in need of services and adjust the content of prevention programs for maximum effectiveness.

### References

- ALTERMAN, A.I., SEARLES, J.S. AND HALL, J.G. Failure to find differences in drinking behavior as a function of familial risk for alcoholism: A replication. *J. Abnorm. Psychol.* **98**: 50-53, 1989.
- ARNETT, J.J. Sensation seeking, aggressiveness, and adolescent reckless behavior. *Pers. Individ. Diff.* **20**: 693-702, 1996.
- BAER, J.S. Effects of college residence on perceived norms for alcohol consumption: An examination of the first year in college. *Psychol. Addict. Behav.* **8**: 43-50, 1994.
- BAER, J.S. AND CARNEY, M.M. Biases in the perceptions of the consequences of alcohol use among college students. *J. Stud. Alcohol* **54**: 54-60, 1993.
- BAER, J.S., MACLEAN, M.G. AND MARLATT, G.A. Linking etiology and treatment for adolescent substance abuse: Toward a better match. In: JESSOR, R. (Ed.) *New Perspectives on Adolescent Risk Behavior*, New York: Cambridge Univ. Press, 1998, pp. 182-220.
- BAER, J.S., NOVICK, N.J. AND HUMMEL-SCHLUGER, A.O. Task persistence after alcohol consumption among children of alcoholics. *Alcsm Clin. Exp. Res.* **19**: 955-960, 1995.
- BAER, J.S., STACY, A. AND LARIMER, M. Biases in the perception of drinking norms among college students. *J. Stud. Alcohol* **52**: 580-586, 1991.
- BARNES, G.M., WELTE, J.W. AND DINTCHEFF, B. Alcohol misuse among college students and other young adults: Findings from a general population study in New York State. *Int. J. Addict.* **27**: 917-934, 1992.
- BAUMRIND, D. The influence of parenting style on adolescent competence and substance use. *J. Early Adolesc.* **11**: 56-95, 1991.
- BECK, K.H., THOMBS, D.L., MAHONEY, C.A. AND FINGAR, K.M. Social context and sensation seeking: Gender differences in college student drinking motivations. *Int. J. Addict.* **30**: 1101-1115, 1995.
- BILLINGHAM, R.E., PARRILLO, A.V. AND GROSS, W.C. Reasons given by college students for drinking: A discriminant analysis investigation. *Int. J. Addict.* **28**: 793-802, 1993.
- BOGART, C.J., YEATMAN, F.R., SIRRIDGE, S.T. AND GEER, F.A. Alcohol expectancies and the personal and parental drinking patterns of women. *Women Hlth* **22** (4): 51-66, 1995.
- BRADLEY, J.R., CARMAN, R.S. AND PETREE, A. Personal and social drinking motives, family drinking history, and problems associated with drinking in two university samples. *J. Drug Educ.* **22**: 195-202, 1992.
- BRENNAN, A.F., WALFISH, S. AND AUBUCHON, P. Alcohol use and abuse in college students: I. A review of individual and personality correlates. *Int. J. Addict.* **21**: 449-474, 1986a.
- BRENNAN, A.F., WALFISH, S. AND AUBUCHON, P. Alcohol use and abuse in college students: II. Social/environmental correlates, methodological issues, and implications for intervention. *Int. J. Addict.* **21**: 475-493, 1986b.
- BROWN, S.A. Expectancies versus background in the prediction of college drinking patterns. *J. Cons. Clin. Psychol.* **53**: 123-130, 1985.
- BUCHOLZ, K.K. A review of correlates of alcohol use and alcohol problems in adolescence. In: GALANTER, M. (Ed.) *Recent Developments in Alcoholism, Vol. 8: Combined Alcohol and Other Drug Dependence*, New York: Plenum Press, 1990, pp. 111-123.
- CAMATTA, C.D. AND NAGOSHI, C.T. Stress, depression, irrational beliefs, and alcohol use and problems in a college student sample. *Alcsm Clin. Exp. Res.* **19**: 142-146, 1995.
- CAREY, K.B. Situational determinants of heavy drinking among college students. *J. Counsel. Psychol.* **40**: 217-220, 1993.
- CAREY, K.B. Alcohol-related expectancies predict quantity and frequency of heavy drinking among college students. *Psychol. Addict. Behav.* **9**: 236-241, 1995a.
- CAREY, K.B. Heavy drinking contexts and indices of problem drinking among college students. *J. Stud. Alcohol* **56**: 287-292, 1995b.
- CAREY, K.B. AND CORREIA, C.J. Drinking motives predict alcohol-related problems in college students. *J. Stud. Alcohol* **58**: 100-105, 1997.
- CASHIN, J.R., PRESLEY, C.A. AND MEILMAN, P.W. Alcohol use in the Greek system: Follow the leader? *J. Stud. Alcohol* **59**: 63-70, 1998.
- CLAPPER, R.L., MARTIN, C.S. AND CLIFFORD, P.R. Personality, social environment, and past behavior as predictors of late adolescent alcohol use. *J. Subst. Abuse* **6**: 305-313, 1994.
- COLDER, C.R. AND CHASSIN, L. Differentiating "substance use" from "problem substance use" in adolescents: Data from a study of adolescents at risk. Paper presented at the annual meeting of the American Psychological Association, Washington, DC, August 1992.
- CORBIN, W.R., MCNAIR, L.D. AND CARTER, J. Self-esteem and problem drinking among male and female college students. *J. Alcohol Drug Educ.* **42**: 1-14, 1996.
- CRONIN, C. Reasons for drinking versus outcome expectancies in the prediction of college student drinking. *Subst. Use Misuse* **32**: 1287-1311, 1997.
- DARKES, J., GREENBAUM, P.E. AND GOLDMAN, M.S. Sensation seeking—disinhibition and alcohol use: Exploring issues of criterion contamination. *Psychol. Assess.* **10**: 71-76, 1998.
- DEYKIN, E.Y., LEVY, J.C. AND WELLS, V. Adolescent depression, alcohol and drug abuse. *Amer. J. Publ. Hlth* **77**: 178-182, 1987.
- DONOVAN, J.E., JESSOR, R. AND JESSOR, L. Problem drinking in adolescence and young adulthood. *J. Stud. Alcohol* **44**: 109-137, 1983.
- EARLEYWINE, M., FINN, P.R. AND MARTIN, C.S. Personality risk and alcohol consumption: A latent variable analysis. *Addict. Behav.* **15**: 183-187, 1990.
- ENGS, R.C. Family background of alcohol abuse and its relationship to alcohol consumption among college students: An unexpected finding. *J. Stud. Alcohol* **51**: 542-547, 1990.
- ENGS, R.C., DIEBOLD, B.A. AND HANSON, D.J. The drinking patterns and problems of a national sample of college students, 1994. *J. Alcohol Drug Educ.* **41**: 13-33, 1996.
- ENGS, R.C. AND HANSON, D.J. Drinking games and problems related to drinking among moderate and heavy drinkers. *Psychol. Rep.* **73**: 115-120, 1993.
- EVANS, D.M. AND DUNN, N.J. Alcohol expectancies, coping responses and self-efficacy judgments: A replication and extension of Cooper et al.'s 1988 study in a college sample. *J. Stud. Alcohol* **56**: 186-193, 1995.
- FROMME, K. AND RUELA, A. Mediators and moderators of young adults' drinking. *Addiction* **89**: 63-71, 1994.

- GEORGE, W.H., LAMARR, J., BARRETT, K. AND MCKINNON, T. Alcoholic parentage, self-labeling, and endorsement of ACOA-codependent traits. *Psychol. Addict. Behav.* **13**: 36-48, 1999.
- GFROERER, J.C., GREENBLATT, J.C. AND WRIGHT, D.A. Substance use in the U.S. college-age population: Differences according to educational status and living arrangement. *Amer. J. Publ. Hlth* **87**: 62-65, 1997.
- GONZALEZ, G.M. Early onset of drinking as a predictor of alcohol consumption and alcohol-related problems in college. *J. Drug Educ.* **19**: 225-230, 1989.
- GREENFIELD, T.K., GUYDISH, J. AND TEMPLE, M.T. Reasons students give for limiting drinking: A factor analysis with implications for research and practice. *J. Stud. Alcohol* **50**: 108-115, 1989.
- HADEN, T.L. AND EDMUNDSON, E.W. Personal and social motivations as predictors of substance use among college students. *J. Drug Educ.* **21**: 303-312, 1991.
- HARRINGTON, N.G., BRIGHAM, N.L. AND CLAYTON, R.R. Differences in alcohol use and alcohol-related problems among fraternity and sorority members. *Drug Alcohol Depend.* **47**: 237-246, 1997.
- HAVEY, J.M. AND DODD, D.K. Variables associated with alcohol abuse among self-identified collegiate COAs and their peers. *Addict. Behav.* **18**: 567-575, 1993.
- HECK, E.J. AND WILLIAMS, M.D. Criterion variability in problem-drinking research on college students. *J. Subst. Abuse* **7**: 437-447, 1995.
- JACOB, T. AND LEONARD, K. Family and peer influences in the development of adolescent alcohol abuse. In: ZUCKER, R., BOYD, G. AND HOWARD, J. (Eds.) *The Development of Alcohol Problems: Exploring the Biopsychosocial Matrix of Risk*. NIAAA Research Monograph No. 26, NIH Publication No. 94-3495, Rockville, MD: Department of Health and Human Services, 1994, pp. 123-155.
- JESSOR, R., DONOVAN, J.E. AND COSTA, F.M. *Beyond Adolescence: Problem Behavior and Young Adult Development*, New York: Cambridge Univ. Press, 1991.
- JOHNSON, P.B. Personality correlates of heavy and light drinking college students. *J. Alcohol Drug Educ.* **34** (2): 33-37, 1989.
- JOHNSON, T.J., HAMILTON, S. AND SHEETS, V.L. College students' self-reported reasons for playing drinking games. *Addict. Behav.* **24**: 279-286, 1999.
- JOHNSON, T.J., WENDEL, J. AND HAMILTON, S. Social anxiety, alcohol expectancies, and drinking-game participation. *Addict. Behav.* **23**: 65-79, 1998.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1994*, Vol. 1, NIH Publication No. 95-4026, Washington: Government Printing Office, 1995.
- JUNG, J. Parent-child closeness affects the similarity of drinking levels between parents and their college-age children. *Addict. Behav.* **20**: 61-67, 1995.
- KIDORF, M., SHERMAN, M.F., JOHNSON, J.G. AND BIGELOW, G.E. Alcohol expectancies and changes in beer consumption of first-year college students. *Addict. Behav.* **20**: 225-231, 1995.
- KUSHNER, M.G. AND SHER, K.J. Comorbidity of alcohol and anxiety disorders among college students: Effects of gender and family history of alcoholism. *Addict. Behav.* **18**: 543-552, 1993.
- KUSHNER, M.G., SHER, K.J. AND ERICKSON, D.J. Prospective analysis of the relation between DSM-III anxiety disorders and alcohol use disorders. *Amer. J. Psychiat.* **156**: 723-732, 1999.
- LEIBSOHN, J. The relationship between drug and alcohol use and peer group associations of college freshmen as they transition from high school. *J. Drug Educ.* **24**: 177-192, 1994.
- LEIBSOHN, M.T., OETTING, E.R. AND DEFFENBACHER, J.L. Effects of trait anger on alcohol consumption and consequences. *J. Child Adolesc. Subst. Abuse* **3** (3): 17-32, 1994.
- LEICHLITER, J.S., MEILMAN, P.W., PRESLEY, C.A. AND CASHIN, J.R. Alcohol use and related consequences among students with varying levels of involvement in college athletics. *J. Amer. Coll. Hlth* **46**: 257-262, 1998.
- LEIGH, B.C. Beliefs about the effects of alcohol on self and others. *J. Stud. Alcohol* **48**: 467-475, 1987.
- LEIGH, B.C. AND STACY, A.W. Alcohol outcome expectancies: Scale construction and predictive utility in higher order confirmatory models. *Psychol. Assess.* **5**: 216-229, 1993.
- LO, C.C. AND GLOBETTI, G. A partial analysis of the campus influence on drinking behavior: Students who enter college as nondrinkers. *J. Drug Issues* **23**: 715-725, 1993.
- MACDONALD, R., FLEMING, M.F. AND BARRY, K.L. Risk factors associated with alcohol abuse in college students. *Amer. J. Drug Alcohol Abuse* **17**: 439-449, 1991.
- MARTSH, C.T. AND MILLER, W.R. Extraversion predicts heavy drinking in college students. *Pers. Individ. Diff.* **23**: 153-155, 1997.
- MEILMAN, P.W., CASHIN, J.R., MCKILLIP, J. AND PRESLEY, C.A. Understanding the three national databases on collegiate alcohol and drug use. *J. Amer. Coll. Hlth* **46**: 159-162, 1998.
- MOONEY, D.K. AND CORCORAN, K.J. The relationship between assertiveness, alcohol-related expectations for social assertion and drinking patterns among college students. *Addict. Behav.* **14**: 301-305, 1989.
- NAGOSHI, C.T., WOOD, M.D., COTE, C.C. AND ABBIT, S.M. College drinking game participation within the context of other predictors of alcohol use and problems. *Psychol. Addict. Behav.* **8**: 203-213, 1994.
- NEWMAN, I.M., CRAWFORD, J.K. AND NELLIS, M.J. The role and function of drinking games in a university community. *J. Amer. Coll. Hlth* **39**: 171-175, 1991.
- NEZLEK, J.B., PILKINGTON, C.J. AND BILBRO, K.G. Moderation in excess: Binge drinking and social interaction among college students. *J. Stud. Alcohol* **55**: 342-351, 1994.
- O'HARE, T. Measuring excessive alcohol use in college drinking contexts: The Drinking Context Scale. *Addict. Behav.* **22**: 469-477, 1997.
- PATOCK-PECKHAM, J.A., HUTCHINSON, G.T., CHEONG, J. AND NAGOSHI, C.T. Effect of religion and religiosity on alcohol use in a college student sample. *Drug Alcohol Depend.* **49**: 81-88, 1998.
- PERKINS, H.W. The contextual effect of secular norms on religiosity as moderator of student alcohol and other drug use. *Res. Social Sci. Stud. Relig.* **6**: 187-208, 1994.
- PERKINS, H.W. Stress-motivated drinking in collegiate and postcollegiate young adulthood: Life course and gender patterns. *J. Stud. Alcohol* **60**: 219-227, 1999.
- PERKINS, H.W. AND BERKOWITZ, A.D. Perceiving the community norms of alcohol use among students: Some research implications for campus alcohol education programming. *Int. J. Addict.* **21**: 961-976, 1986.
- PERKINS, H.W. AND BERKOWITZ, A.D. Collegiate COAs and alcohol abuse: Problem drinking in relation to assessments of parent and grandparent alcoholism. *J. Counsel. Devel.* **69**: 237-240, 1991.
- PERKINS, H.W., MEILMAN, P.W., LEICHLITER, J.S., CASHIN, J.R. AND PRESLEY, C.A. Misperceptions of the norms for the frequency of alcohol and other drug use on college campuses. *J. Amer. Coll. Hlth* **47**: 253-258, 1999.
- PERKINS, H.W. AND WECHSLER, H. Variation in perceived college drinking norms and its impact on alcohol abuse: A nationwide study. *J. Drug Issues* **26**: 961-974, 1996.
- POULSON, R.L., EPPLER, M.A., SATTERWHITE, T.N., WUENSCH, K.L. AND BASS, L.A. Alcohol consumption, strength of religious beliefs, and risky sexual behavior in college students. *J. Amer. Coll. Hlth* **46**: 227-232, 1998.
- PRENTICE, D.A. AND MILLER, D.T. Pluralistic ignorance and the perpetuation of social norms by unwitting actors. *Adv. Exp. Social Psychol.* **28**: 161-209, 1996.
- PULLEN, L.M. The relationships among alcohol abuse in college students and selected psychological/demographic variables. *J. Alcohol Drug Educ.* **40** (1): 36-50, 1994.
- RATLIFF, K.G. AND BURKHART, B.R. Sex differences in motivations for and effects of drinking among college students. *J. Stud. Alcohol* **45**: 26-32, 1984.

- RODNEY, H.E. AND RODNEY, L. An exploratory study of African American collegiate adult children of alcoholics. *J. Amer. Coll. Hlth* **44**: 267-272, 1996.
- ROSENBLUTH, J., NATHAN, P.E. AND LAWSON, D.M. Environmental influences on drinking by college students in a college pub: Behavioral observation in the natural environment. *Addict. Behav.* **3**: 117-121, 1978.
- SCHULENBERG, J., MAGGS, J.L., LONG, S.W., SHER, K.J., GOTHAM, H.J., BAER, J.S., KIVLAHAN, D.R., MARLATT, G.A. AND ZUCKER, R.A. The problem of college drinking: Insights from a developmental perspective. *Alcsm Clin. Exp. Res.* **25**: 473-477, 2001.
- SENCIAK, M., LEONARD, K.E. AND GREENE, B.W. Alcohol use among college students as a function of their typical social drinking context. *Psychol. Addict. Behav.* **12**: 62-70, 1998.
- SHER, K.J., BARTHOLOW, B.D. AND NANDA, S. Short- and long-term effects of fraternity and sorority membership on heavy drinking: A social norms perspective. *Psychol. Addict. Behav.* **15**: 42-51, 2001.
- SHER, K.J. AND TRULL, T.J. Personality and disinhibitory psychopathology: Alcoholism and antisocial personality disorder. *J. Abnorm. Psychol.* **103**: 92-102, 1994.
- SHER, K.J., TRULL, T.J., BARTHOLOW, B.D. AND VIETH, A. Personality and alcoholism: Issues, methods, and etiological processes. In: LEONARD, K.E. AND BLANE, H.T. (Eds.) *Psychological Theories of Drinking and Alcoholism*, 2nd Edition, New York: Guilford Press, 1999, pp. 54-105.
- SHER, K.J., WOOD, M.D., WOOD, P.K. AND RASKIN, G. Alcohol outcome expectancies and alcohol use: A latent variable cross-lagged panel study. *J. Abnorm. Psychol.* **105**: 561-574, 1996.
- STACY, A.W., LEIGH, B.C. AND WEINGARDT, K.R. Memory accessibility and association of alcohol use and its positive outcomes. *Exp. Clin. Psychopharmacol.* **2**: 269-282, 1994.
- TARTER, R.E. AND VANYUKOV, M. Alcoholism: A developmental disorder. *J. Cons. Clin. Psychol.* **62**: 1096-1107, 1994.
- THOMBS, D.L. AND BECK, K.H. The social context of four adolescent drinking patterns. *Hlth Educ. Res.* **9**: 13-22, 1994.
- THOMBS, D.L., BECK, K.H. AND PLEACE, D.J. The relationship of social context and expectancy factors to alcohol use intensity among 18 to 22 year-olds. *Addict. Res.* **1**: 59-68, 1993.
- THOMBS, D.L., WOLCOTT, B.J. AND FARKASH, L.G.E. Social context, perceived norms and drinking behavior in young people. *J. Subst. Abuse* **9**: 257-267, 1997.
- VALLIANT, P.M. AND SCANLAN, P. Personality, living arrangements, and alcohol use by first year university students. *Social Behav. Pers.* **24**: 151-156, 1996.
- WALITZER, K.S. AND SHER, K.J. A prospective study of self-esteem and alcohol use disorders in early adulthood: Evidence for gender differences. *Alcsm Clin. Exp. Res.* **20**: 1118-1124, 1996.
- WECHSLER, H., DOWDALL, G.W., DAVENPORT, A. AND CASTILLO, S. Correlates of college student binge drinking. *Amer. J. Publ. Hlth* **85**: 921-926, 1995.
- WECHSLER, H., MOLNAR, B.E., DAVENPORT, A.E. AND BAER, J.S. College alcohol use: A full or empty glass? *J. Amer. Coll. Hlth* **47**: 247-252, 1999.
- WECHSLER, H. AND ROHMAN, M. Extensive users of alcohol among college students. *J. Stud. Alcohol* **42**: 150-155, 1981.
- WEISS, L.H. AND SCHWARZ, J.C. The relationship between parenting types and older adolescents' personality, academic achievement, adjustment, and substance use. *Child Devel.* **67**: 2101-2114, 1996.
- WERNER, M.J., WALKER, L.S. AND GREENE, J.W. Relation of alcohol expectancies to changes in problem drinking among college students. *Arch. Pediat. Adolesc. Med.* **149**: 733-739, 1995.
- WIGGINS, B. AND WIGGINS, J.A. Specification of the association between sociability and drinking level among college students. *J. Stud. Alcohol* **53**: 137-141, 1992.
- WOOD, M.D., NAGOSHI, C.T. AND DENNIS, D.A. Alcohol norms and expectations as predictors of alcohol use and problems in a college student sample. *Amer. J. Drug Alcohol Abuse* **18**: 461-476, 1992.
- WOOD, M.D., SHER, K.J. AND STRATHMAN, A. Alcohol outcome expectancies and alcohol use and problems. *J. Stud. Alcohol* **57**: 283-288, 1996.
- WOOD, M.D., VINSON, D.C. AND SHER, K.J. Alcohol use and misuse. In: BAUM, A., REVENSON, T. AND SINGER, J. (Eds.) *Handbook of Health Psychology*, Mahwah, NJ: Lawrence Erlbaum, 2001, pp. 281-318.
- ZUCKER, R.A. The four alcoholisms: A developmental account of the etiologic process. In: RIVERS, P.C. (Ed.) *Alcohol and Addictive Behaviors* (Nebraska Symposium on Motivation, 1986, Vol. 34), Lincoln, NE: Univ. of Nebraska Press, 1987, pp. 27-83.
- ZUCKER, R.A. Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholisms and for contextual contributions to risk. In: ZUCKER, R., BOYD, G. AND HOWARD, J. (Eds.) *The Development of Alcohol Problems: Exploring the Biopsychosocial Matrix of Risk*. NIAAA Research Monograph No. 26, NIH Publication No. 94-3495, Rockville, MD: Department of Health and Human Services, 1994, pp. 255-289.
- ZUCKER, R.A., FITZGERALD, H.E. AND MOSES, H.D. Emergence of alcohol problems and the several alcoholisms: A developmental perspective on etiologic theory and life course trajectory. In: CICHETTI, D. AND COHEN, D.J. (Eds.) *Developmental Psychopathology, Vol. 2: Risk, Disorder, and Adaptation*, New York: John Wiley & Sons, 1995, pp. 677-711.

# A Developmental Perspective on Alcohol Use and Heavy Drinking during Adolescence and the Transition to Young Adulthood\*

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**ABSTRACT.** *Objective:* This article offers a developmental perspective on college drinking by focusing on broad developmental themes during adolescence and the transition to young adulthood. *Method:* A literature review was conducted. *Results:* The transition to college involves major individual and contextual change in every domain of life; at the same time, heavy drinking and associated problems increase during this transition. A developmental contextual perspective encourages the examination of alcohol use and heavy drinking in relation to normative developmental tasks and transitions and in the context of students' changing lives, focusing on interindividual variation in the course and consequences of drinking and on a wide range of proximal and distal influences. Links between developmental transitions and alcohol use and

other health risks are discussed in light of five conceptual models: Overload, Developmental Mismatch, Increased Heterogeneity, Transition Catalyst and Heightened Vulnerability to Chance Events. We review normative developmental transitions of adolescence and young adulthood, focusing on the domains of physical and cognitive development, identity, affiliation and achievement. *Conclusions:* As shown in a selective review of empirical studies, these transitions offer important vantage points for examining increasing (and decreasing) alcohol and other drug use during adolescence and young adulthood. We conclude with a consideration of research and intervention implications. (*J. Stud. Alcohol*, Supplement No. 14: 54-70, 2002)

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*"I'm 21 and in my prime drinking years, and I intend to take full advantage of it!"*

—College student, after a few drinks at a wedding

AS RESEARCHERS and practitioners, we may sometimes underestimate the clarity of young people's thinking about their alcohol use. Most view late adolescence and early adulthood as a time when drinking is common and accepted. Among those who drink, the large majority perceive social and coping benefits of alcohol use and even occasional heavy drinking; they tend to limit their drinking such that it interferes little with work and school responsibilities; and they will diminish their heavy drinking as they move into adult roles. Although many experience negative consequences, most make it through their "prime drinking years" with, in balance, more positive experiences with alcohol than negative ones. At the same time, alcohol use becomes problematic and tragic for many. Heavy drinking, alcohol-related problems and associated risky and illegal behaviors peak during late adolescence and early

adulthood (Baer, 1993; Johnston et al., 2001a,b), as do problems with substance use in general (Glantz et al., 1999; Johnston et al., 2001a,b). This period is an important juncture in the etiology of alcohol misuse and alcoholism, a time when initiation and escalation of heavy drinking may set the stage for lifelong difficulties (e.g., Babor et al., 1992; Zucker, 1987). Even sporadic drinking can lead to a life-altering tragedy when combined with a lapse of judgment or with simple misfortune.

Recognizing how drinking fits into the lives of most young people is a necessary foundation for effective remedies. In the United States (and many other countries; Fillmore et al., 1993), alcohol use and heavy drinking are culturally embedded in the experience of adolescence and the transition to young adulthood in general (Blane, 1979; Donovan et al., 1983) and in the college experience in particular (Straus and Bacon, 1953; Wechsler et al., 1998). During high school, college-bound students have *lower* rates of alcohol and other drug use than their noncollege-bound classmates; in the years immediately following high school, however, college students have *higher* rates of alcohol use and frequent heavy drinking (but still lower rates of use of other substances) (Johnston et al., 2001a,b; Schulenberg et al., 2001a).

Perhaps most indicative of the embeddedness of heavy drinking in the transition to young adulthood is the remarkable historical stability in rates of frequent heavy drinking

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\*This work was supported in part by National Institute on Alcohol Abuse and Alcoholism grants R01-AA06324 and R03-AA09143 (PI: J. Schulenberg) and the Alcoholic Beverage Medical Research Foundation (PI: J. Maggs).

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(i.e., five or more drinks in a row). During the past two decades, despite many social, demographic, political and economic changes—and despite dramatic shifts in cigarette and illicit drug use—rates of frequent heavy drinking among those ages 19-22 have shifted little (average 2-week rate of 39%), especially for college students (42%) (Johnston et al., 2001a,b). This imperviousness to historical change, and to numerous national and local intervention efforts, suggests that excessive drinking during the transition to young adulthood and especially in college is overdetermined (see Wechsler et al., 1998). This is not to justify excessive drinking nor to convey pessimism about the effectiveness of ongoing interventions, but rather to underscore that a multitude of forces at the cultural and individual levels keep this phenomenon in place for many young people.

Our purpose is to provide a developmental perspective on college drinking by examining how the many developmental transitions of adolescence and young adulthood relate to the etiology of alcohol use and heavy drinking. By taking this broader developmental view, we hope to portray the many ways that drinking can fit into the lives of young people in general, and college students in particular. We first consider the meaning and importance of taking a developmental perspective. We then present a conceptual and empirical summary of normative developmental transitions and discuss how they relate to alcohol use. We conclude with a discussion of research, intervention and policy implications.

### **Developmental Perspective on the Etiology of Alcohol Use and Heavy Drinking**

An important question for anyone interested in adolescence is the extent to which this time in life is inherently troublesome. G. Stanley Hall (1904), the founder of the scientific study of adolescence (Muuss, 1996), gave us the enduring image of adolescence as a time of unavoidable “storm and stress.” According to Hall, we can do little to ease adolescents’ pain because development is largely controlled by evolution and biology and thus generally unaffected by culture or context. That is, adolescence is “just a stage,” and when it passes, civility and mental health will return. This view is consistent with psychoanalytic theories: Anna Freud (1958), in particular, argued that the *lack* of adolescent storm and stress signified psychopathology. In contrast, Margaret Mead (1950) and Ruth Benedict (1950) viewed storm and stress primarily as a cultural phenomenon due to the discontinuity in roles and responsibilities between childhood and adulthood in modern societies (see also Schlegel and Barry, 1991). Similarly, Robert Havighurst (1952) viewed adolescent difficulties in terms of a failure to accomplish necessary age-graded, culturally defined developmental tasks.

Although diversity in present-day scientific images of adolescence remains, reflecting strong roots in biology and culture, the notion that adolescence is *necessarily* a turbulent time has received little empirical support (e.g., Douvan and Adelson, 1966; Lerner and Galambos, 1998). A common view consistent with our own perspective is that “adolescence is characterized by change, and is challenging, but it need not be tumultuous and problematic unless societal conditions prompt it” (Petersen and Leffert, 1995, p. 3). Building on this view, this section provides a brief discussion of some key developmental themes as they relate to the etiology of alcohol use and heavy drinking during adolescence and the transition to young adulthood (see also Schulenberg and Maggs, 2001; Schulenberg et al., 2001b).

### *Developmental-contextual perspective*

The developmental-contextual perspective emphasizes multidimensional and multidirectional development across the life span, characterized by a dynamic and progressive mutual selection and accommodation of individuals and their contexts (Baltes, 1987; Elder, 1998; Lerner, 1982; Sameroff, 1987). Humans are viewed as playing a strong role in their own development (Caspi and Moffitt, 1993; Lerner, 1982; Scarr and McCartney, 1983). Through a process of niche selection, individuals elect environments and activities based on personal characteristics, skills, beliefs and goals. Selected ecological niches then expose them to various opportunities and constraints (Nurmi, 1993; Plomin et al., 1997; Scarr and McCartney, 1983).

To help envision contextual influences and person-context interactions on development, Bronfenbrenner (1979) offered an ecology of human development framework that involves nested, interconnected systems to represent the structure of the social context. The developing individual’s primary contexts (microsystems) include, for example, his or her family and school. Interrelations among microsystems (mesosystems) are extremely important in that harmonious ties among microsystems (e.g., supporting common goals for the developing individual) are generally viewed as beneficial. Additional systems include exosystems (i.e., influential external contexts, such as the child’s parents’ work settings) and macrosystems (i.e., broader cultural and historical influences) in which all the other systems are embedded.

Central to our goal of linking developmental transitions with alcohol use are ecological transitions, which Bronfenbrenner (1979) defined as occurring “whenever a person’s position in the ecological environment is altered as a result of a change in role, setting, or both” (p. 26). Ecological transitions typically involve changes at the individual, microsystem and mesosystem levels. As a result of a given transition, mesosystems among new and recurring micro-



systems may become stronger or weaker, which in turn has implications for the developing individual's health and well-being. Furthermore, links between pretransitional microsystems (e.g., high school) and new microsystems (e.g., college) can be viewed as mesosystems as well, suggesting the importance of contextual influences on successful adaptation during transitions.

This emphasis on ecological transitions highlights both developmentally proximal and distal influences on behavior, setting the foundation for considerations of turning points and developmental discontinuity (Elder, 1998; Rutter, 1996). Furthermore, following from the emphasis on person-context interactions, considerations of interindividual similarities and differences in intraindividual change are essential, with less emphasis on normative trends in developmental change and more emphasis on different trajectories of change over time.

As we illustrate throughout this article, key developmental themes—including person-context interactions, continuity and discontinuity, distal and proximal influences and individual differences and similarities in intraindividual change—represent important foundations for understanding how alcohol and other drug use fits into the lives of young people.

### *Trajectories of frequent heavy drinking*

When considering the etiology of heavy drinking during adolescence and the transition to young adulthood, it is essential to examine different trajectories of drinking over time; otherwise, one may be misled by the normative developmental trend and fail to appreciate the wide diversity of patterns of change in heavy drinking over time (e.g., Bates and Labouvie, 1997; Guo et al., 2000; Muthén and Muthén, 2000; NIAAA, 2000). For example, based on the Monitoring the Future data, Schulenberg et al. (1996a) examined distinct trajectories of change in frequent heavy drinking (i.e., five or more drinks in a row) across four waves during the transition to young adulthood (ages 18-24). Using conceptual groupings and cluster analysis, they found six trajectory groups labeled as Chronic, Decrease, Increase, Fling, Rare and Never. (About 10% of the sample was Other.) The mean scores for these trajectory groups (except the Never group, representing 36% of the sample) are illustrated in Figure 1. Note the discrepancy between what is learned from the "total" line versus from the trajectory group lines.

There are important differences in the prevalence of the trajectory groups according to demographic factors and

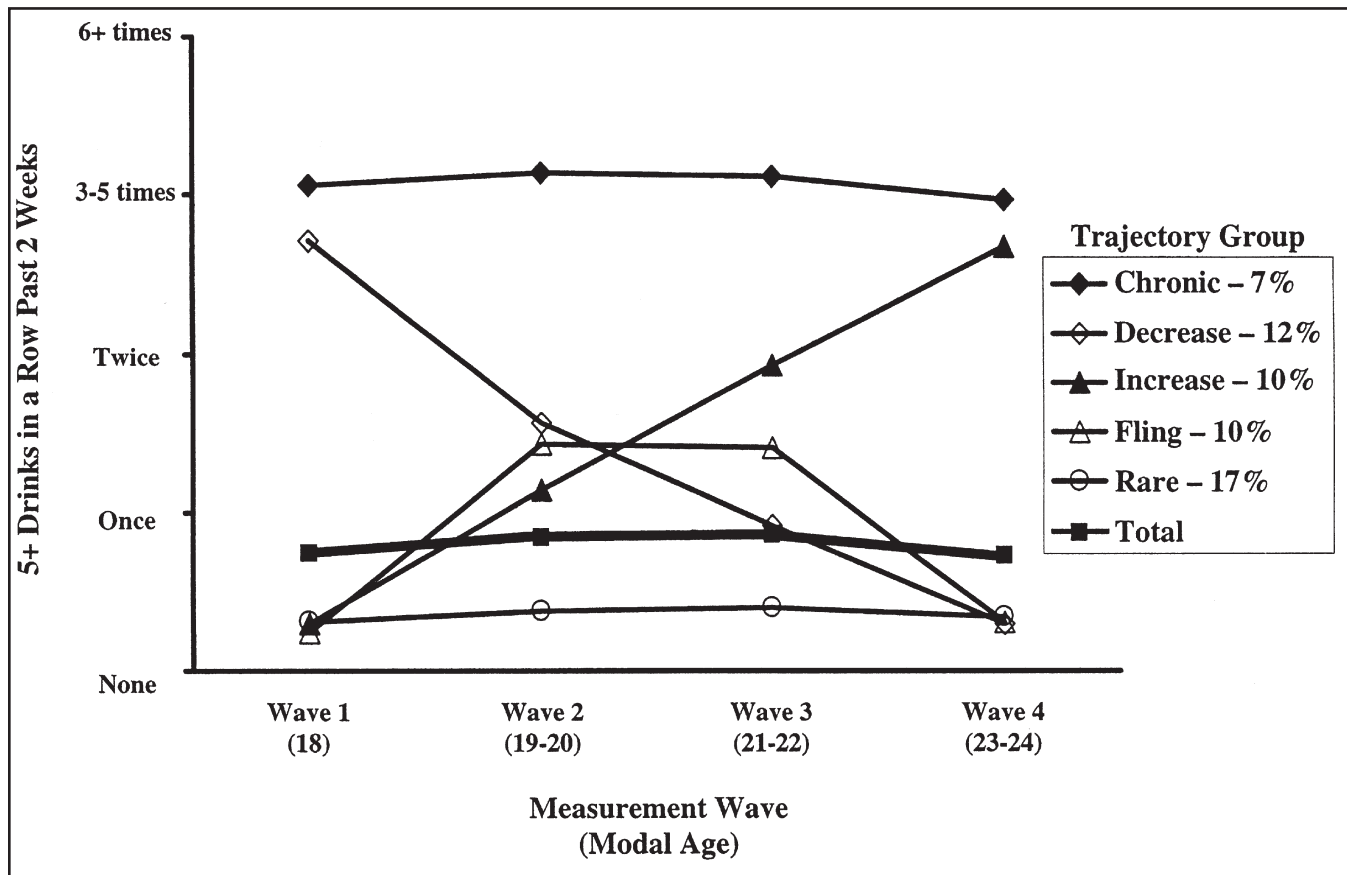


FIGURE 1. Mean score for 5+ drinks in a row in past 2 weeks by frequent heavy drinking trajectory group

student status. Women are underrepresented in the Chronic and Increase groups and overrepresented in the Never group; white youths are generally overrepresented in all heavy episodic drinking groups except the Never group. Compared with their noncollege agemates, college students are overrepresented in the Increase and Fling groups and underrepresented in the Decrease group. Compared with students who live with their parents, those who live away and especially those who are active in fraternities or sororities are overrepresented in the Chronic, Increase and Fling groups and underrepresented in the Never group (Schulenberg, 1999; Schulenberg et al., 1996a; see also Bachman et al., 1997).

By focusing on differential change in alcohol use, we can see more clearly how a given level of use at one point in time represents a number of different more or less troublesome trajectories. Frequent heavy drinking during the first year of college may reflect continuity of a pattern established in high school, or it may reflect a newly emergent, time-limited pattern (see Figure 1). Similarly, as Weber et al. (1989) found among two groups of high school students with similarly high levels of substance use, one group had a lengthy prior history of persistent and severe difficulties, and the other group had only recent and moderate difficulties. In these examples, which illustrate the concept of equifinality (discussed below), different trajectories that lead to similar endpoints can reflect very different antecedents and possible remedies (Loeber, 1982; Moffitt, 1993; Moffitt et al., 1996; Zucker et al., 1995). Likewise, heavy drinking during the first year of college may or may not reflect a future escalating trajectory (illustrating multifinality, discussed below). Although many young people who misuse substances experience ongoing misuse extending into adulthood, most desist with the onset of adulthood roles (Bachman et al., 1997; Jessor et al., 1991). These two distinct trajectories of misuse stemming from a similar initial level have different implications for consequences and remedies.

#### *Risk and protective factors from a developmental perspective*

A more developmentally sensitive understanding of risk and protective factors will provide a stronger foundation for addressing fundamental questions about substance use etiology and intervention (Clayton, 1992; Schulenberg et al., 2001b). A quarter century of empirical work has yielded a large and sometimes overwhelming array of substance use risk and protective factors (e.g., see Hawkins et al., 1992; Petraitis et al., 1995). The task now for scientists is to understand more fully how risk and protective factors are linked with substance use within individuals over time and across contexts (Bates and Labouvie, 1995; Cicchetti, 1999). Below, we highlight three key issues of concern

when examining risk and protective factors from a developmental perspective (see also Schulenberg et al., 2001b).

*Relationship between risk and protective factors.* Risk and protective factors can be viewed as opposite ends of the same continuum. An alternative view is that protective factors moderate or buffer the effects of risk factors (Brook et al., 1992; Garnezy et al., 1984; Hawkins et al., 1992; Lonczak et al., 2001); that is, protective factors operate in the presence of risk factors whose effects they attenuate. A supportive family context, for example, may have a stronger protective effect on substance use in the presence of negative peer influences (Marshal and Chassin, 2000; Oetting and Beauvais, 1986). Protective factors also may operate by reducing the likelihood of risk factors (e.g., strong family relations reduce the presence of negative peer influences by influencing the adolescent's choice of friends).

*Equifinality and multifinality.* One of the most compelling reasons for long-term panel studies on substance use is to identify why great numbers of individuals do not develop serious substance misuse problems despite exposure to significant risk factors, and likewise why many individuals do develop problems despite little exposure to risk factors (Andersson, 2000; Cicchetti, 1999; NIAAA, 2000; Rutter, 1989). The concepts of equifinality and multifinality highlight the probabilistic nature of risk and protective factors (Cicchetti and Rogosch, 1996). With equifinality, different distinct constellations of risk and protective factors can lead to the same outcome. For example, heavy drinking in college may be caused, in part, by parental alcoholism for some young people and by social anxiety for others. With multifinality, a given constellation of risk and protective factors can lead to many alternative outcomes. Parental alcoholism, for example, increases the likelihood of alcohol misuse and dependence (Sher, 1991) as well as of becoming an abstainer. No single risk or protective factor is sufficient or necessary for particular outcomes, thus requiring conceptualizations that focus on the diversity of causal connections (Cairns et al., 1998; Cloninger et al., 1997; Newcomb, 1997; Wachs, 2000).

*Robustness and continuity of risk and protective factors.* Very few risk or protective factors are universal, but rather vary by important demographic and individual characteristics, such as gender (e.g., Hops et al., 1999; Wilsnack, 1995). Likewise, very few risk or protective factors are developmentally continuous. In particular, risk factors for substance use onset may be quite different from risk factors for substance use maintenance and escalation (e.g., Ellickson and Hays, 1991; Newcomb, 1997) and may vary with age at onset (Brook et al., 1999).

Risk and protective factors can be viewed as being robust (i.e., predict current levels of and future changes in substance use), emergent (i.e., predict future changes but not current levels) or concurrent (i.e., predict current levels but not changes). For example, Schulenberg et al. (1996b)

found that at age 18 the drinking motivation of “to get drunk” was a robust risk factor and self-efficacy was an emergent protective factor with respect to current and future increases in heavy drinking. But concurrent risk and protective factors are far more common, and, in longitudinal studies spanning the transition to young adulthood, most substance use risk and protective factors are only concurrent (e.g., Bates and Labouvie, 1997; Gore et al., 1997; Schulenberg et al., 1996b). Concurrent risk and protective factors may change in unison with the changes in substance use, reflecting a continuous association with substance use and their reciprocal relations (Kandel and Raveis, 1989), or they may simply be developmentally limited. Concurrent risk and protective factors may also represent more developmentally or contextually proximal influences, perhaps mediating the effects of distal influences (see Hussong and Chassin, 1997; MacKinnon, 1994; Patterson et al., 1989; Petraitis et al., 1995).

### **Developmental Transitions and Health Risks during Adolescence and Young Adulthood**

The passage into young adulthood is a critical time during which diversity in life trajectories increases (Schulenberg et al., 2000; Sherrod et al., 1993). For many, this period begins when the young adult moves away from home to begin college and live in student residences. As with other developmental changes, this transition involves both gains and losses (Baltes, 1987; Cantor and Langston, 1989), such as new friendship networks, but separation from family and old friends; more academic choices, but new academic demands; and increased independence, but decreased parental guidance and support. Amid all these transitions, alcohol use and heavy drinking tend to escalate, a co-occurrence that is far more than coincidental.

In this section and the next, we address this co-occurrence by examining how various developmental transitions relate to substance use. Building on the developmental contextual perspective, we discuss definition and conceptual issues regarding transitions and examine five conceptual models concerning the link between transitions and health risks.

#### *Defining and conceptualizing developmental transitions*

Developmental transitions are “the paths that connect us to transformed physical, mental, and social selves” (Schulenberg et al., 1997, p. 1). Puberty represents an obvious major transition, as does moving from high school to college, from school to work and from being single to getting married. There are many other more subtle yet significant transitions. For example, a young adolescent who usually does what she is told begins to argue persuasively against her parents’ directives; a small same-sex group of

friends becomes folded into a larger group made up of boys and girls, which in turn is replaced by individual friendships and dating relationships; and a concrete and typically unquestioned self-definition becomes more abstract and tentative, and eventually more hierarchic and future oriented. Together, these and many other transitions provide the structure that transforms children into adolescents and adolescents into young adults.

Individuals can shape their own developmental transitions, as they act on and are acted on by their contexts (Lerner, 1982; Scarr and McCartney, 1983). Indeed, the transition to adulthood years is characterized by increasingly diverse options, opportunities and constraints, and thus behavioral choices may influence transition outcomes to a greater extent than ever before. Developmental transitions are embedded in a sociocultural context and therefore may vary by gender, class, culture and historical period. Culturally based, age-related expectations, or “scripts,” shape these transitions by providing a normative timetable and agenda (e.g., for employment, parenthood) (Neugarten, 1979). Developmental transitions can be normative or nonnormative and can vary in timing, sequence and importance depending on their prevalence within a given population and on personal goals and life situations (Baltes, 1987; Nurmi, 1997).

*Developmental transitions, tasks and trajectories.* Developmental transitions are similar to developmental tasks (Havighurst, 1952), which are socially and biologically prescribed psychosocial tasks that “should” be accomplished during specific sensitive periods across the life span. Although transitions and tasks are related and sometimes even overlap (e.g., the task of selecting a mate versus the transition to marriage), transitions pertain more to the actual process of change than to the accomplishments that contribute to and result from the changes. Transitions are also distinct from trajectories (see Cairns and Cairns, 1994; Crockett and Crouter, 1995), which refer to patterns of systematic and successive change over time that can incorporate several developmental transitions (Elder, 1998). By viewing transitions as embedded in ongoing individual trajectories, it is possible to consider transitions as potential turning points reflecting successive increases or decreases in functioning (Rutter, 1996).

*Discontinuity and continuity.* Issues of discontinuity and continuity are central to understanding the power of major developmental transitions on individuals’ lives (Petersen, 1993; Rutter, 1996). For instance, apparent discontinuities in functioning across transitions may reflect momentary disturbances, after which one’s ongoing trajectory will resume. Likewise, change in functioning during a transition that appears to reflect discontinuity may represent the continuity of adaptation (i.e., phenotypic discontinuity may reflect genotypic continuity) (NIAAA, 2000). But consistent with a developmental-contextual perspective, particularly with the

notion of ecological transitions (Bronfenbrenner, 1979), major transitions like the transition to college can permanently alter one's ongoing trajectory of health and well-being. Indeed, such transitions can be viewed as catalysts or even primary mechanisms for the multifinality of earlier experiences. For example, although the majority mature out of their heavy drinking (Bachman et al., 1997), some continue into adulthood with increasing heavy drinking and related problems. Differentiating these two groups before the transition is difficult (e.g., Baer, 1993; Blane, 1979; Jackson et al., 2001; Windle and Davies, 1999), suggesting that the transition itself may impact the continuation of alcohol-related problems into adulthood (see Tarter and Vanyukov, 1994).

*Distal and proximal developmental influences.* Closely tied to issues of continuity and discontinuity are distal and proximal developmental influences. Developmental transitions reflect proximal developmental influences. Distal and proximal influences are often intertwined: Distal influences may structure proximal influences, and in turn proximal influences may mediate the effects of distal influences. But proximal developmental influences in general and developmental transitions in particular may operate independently of distal influences or may even disrupt distal influences, thus setting the stage for discontinuity.

#### *Conceptual models relating developmental transitions to substance use*

Behavioral and lifestyle health risks tend to increase during adolescence as a direct or indirect function of numerous developmental transitions. To consider this relationship between transitions and health risk changes, and specifically college-relevant transitions and substance use, we briefly describe five interrelated conceptual models based on our previous work (Schulenberg and Maggs, 2001; Schulenberg et al., 1997, 2001b) and that of others (Graber et al., 1998). The models are summarized in Table 1; intervention implications are discussed later.

The Overload Model views health risks as a potential result of experiencing multiple developmental transitions over a relatively short time. This model is consistent with cumulative stress theory, drawing attention to the multiple role changes demanded by major life transitions (Coleman, 1989; Simmons and Blyth, 1987). In the transition to college, individuals begin as adolescents and end as young adults; they change from high school to university student status, sibling to roommate, child in a family to adult in an apartment or residence hall and so on. When multiple transitions overwhelm coping capabilities, well-being may suffer. Health risk behaviors including substance use may serve as alternative coping strategies (Dampousse and Kaplan, 1998; Pandina et al., 1990; Wills and Hirký, 1996).

The Developmental Mismatch Model highlights how developmental transitions can alter the match between individuals and their contexts. Building on person-environment fit theory, the developing individual is viewed as embedded in a changing ecological niche, such that the match between individual developmental needs and opportunities provided by the context is itself dynamic (e.g., Eccles et al., 1993; Galambos and Ehrenberg, 1997; Lerner, 1982). Transitions can improve the match and thus provide opportunities for increased health, or they can lessen the match and thus adversely affect health. In many ways, the transition to college (and to young adulthood more generally) represents a new beginning with opportunities to make new friends, enjoy newfound freedom, explore educational and future career alternatives and experiment with different behaviors and lifestyles. For most young people, such opportunities provide an improved match with their developmental needs, which helps explain why well-being tends to increase more rapidly for those students who go away to college (Schulenberg et al., 2000). For others, however, these opportunities may not match their needs, thus setting the stage for increased health risks (e.g., by their seeking fulfillment in unhealthy compensatory contexts). Transitions may also affect health by altering the match between the individual's immediate contexts (i.e., the mesosystem level) (Bronfenbrenner, 1979). For example, if new peer and academic contexts engender significantly competing goals, health risks are likely to increase.

The Increased Heterogeneity Model suggests that challenging transitions magnify existing strengths and weaknesses, thus increasing interindividual differences in functioning and adjustment. These differences tend to increase throughout adolescence between those who cope effectively with various stressors and those who do not (e.g., Kazdin, 1993; Petersen, 1993). Young people already experiencing difficulties (perhaps including difficulties in negotiating earlier major transitions) may have more trouble in negotiating new transitions and fall further behind their well-functioning peers. For vulnerable individuals who lack social, academic and organizational skills, moving away from home to live in an unfamiliar university environment can be intensely stressful (Compas et al., 1986; Shaver et al., 1985; Zirkel, 1992). In contrast, socially and academically confident students may be primed to take advantage of all that the college experience has to offer. This third model represents, in part, an elaboration of the first two models; it focuses on individual differences in ongoing developmental trajectories and thus interweaves distal and more proximal developmental influences (e.g., see Cairns and Cairns, 1994; Caspi et al., 1988; Crockett and Crouter, 1995).

In the Transition Catalyst Model, risk taking in general is viewed as an important component of negotiating certain

TABLE 1. Conceptual models relating developmental transitions to health risks

Model descriptions	Examples	Intervention implications
<i>Overload</i> Multiple developmental transitions overwhelm coping capacities, resulting in increased health risk behaviors.	Use of alcohol to attempt to cope with heightened stress caused by experiencing multiple transitions.	Stagger timing of major transitions; increase coping capacities.
<i>Developmental Mismatch</i> Developmental transitions alter the goodness-of-fit between individuals and their contexts, resulting in changes in health risk behaviors.	Transition decreases match between needs of individual and opportunities provided in context, resulting in seeking alternative contexts involving increased heavy drinking and other risky behaviors.	Increase match between individual needs and opportunities in context; provide better matching alternative contexts.
<i>Increased Heterogeneity</i> Developmental transitions exacerbate individual differences in ongoing health/well-being trajectories.	Individuals already running an emotional/psychological deficit have difficulty negotiating new transition, resulting in increased alcohol use as a form of self-medication.	Through targeted efforts, counter individual deficits and social networks supportive of problem behaviors.
<i>Transition Catalyst</i> Health risk behaviors may assist in, or be fundamental parts of, negotiating certain developmental transitions.	Alcohol use increases because it is believed to facilitate new friendships, romantic/sexual relations and social bonding.	Provide alternative routes to meeting social and sensation-seeking goals.
<i>Heightened Vulnerability to Chance Events</i> Developmental transitions can increase likelihood and effects of positive and negative chance events.	Increased exploratory behavior of new contexts contributes to novel experiences, including heavy drinking and associated negative effects.	Increase awareness of, and resiliency to, potential negative effects of chance events.

developmental transitions. The idea that some amount of risk taking is normative is supported by high prevalence rates and evidence that it may accompany healthy personality development (e.g., Baumrind, 1987; Silbereisen et al., 1986). According to Chassin et al. (1989), risk taking and even deviance can serve “constructive” as well as “destructive” functions in health and development (see also Jessor and Jessor, 1977; Silbereisen and Noack, 1986; Spear, 2000). As Maggs (1997) demonstrated, alcohol use during the transition to college may help to achieve valued social goals, such as making new friends, yet may threaten safety and short- and long-term health and well-being. Alternatively, substance use can be used to avoid transitions, such as remaining as a “full-time” undergraduate student for 5, 6 or more years and thus delaying adult roles and responsibilities.

The Heightened Vulnerability to Chance Events Model is based on the role of chance in altering the courses of lives (Bandura, 1982) and thus addresses the question of why many difficulties are seemingly unpredictable. Just as there are interindividual differences in receptivity to chance events, there are also intraindividual fluctuations in this receptivity, with certain periods along the life span being more amenable to chance effects. Major developmental tran-

sitions that involve new contexts, such as the transition to college, may be particularly propitious junctures because they engender heightened sensitivity to, and exploratory behavior of, the new context and the self in relation to the new context. Young people in transition are likely to seek out, and be open to the effects of, many novel experiences, which increases their vulnerability to the negative effects of chance events, including increased substance use and increased negative consequences of such use.

These five models are not mutually exclusive. Although some of the models can be viewed as competing ones (especially the first three), they are more appropriately viewed as representing the diverse array of connections between developmental transitions and health risks, especially substance use. Together, the five models represent only part of the total relational structure between substance use and developmental influences, correlates and outcomes. These models, by focusing on transitions, highlight the more developmentally proximal and contextually based connections with substance use, a set of connections that are central to understanding college drinking. Simply, when searching for the developmental roots of college drinking, it is often unnecessary or unproductive to go very far “upstream.” This

is not to deny distal and longer term developmental influences on college drinking, and indeed our Increased Heterogeneity Model interweaves developmental transition influences with ongoing health risk trajectories. Clearly, there are powerful early influences that exert ongoing direct and indirect effects on individuals' adjustment in general and alcohol use and misuse in particular (Chassin et al., 1999b; NIAAA, 2000; Sher et al., 1999; Windle and Davies, 1999). As we discussed earlier, integrating our proximal focus with the predominant longer term developmental focus can yield broader models that more fully capture the complexities of developmental-substance use relationships.

### Domains of Developmental Transitions and Alcohol Use

We now turn to a consideration of the specific developmental transitions of adolescence and young adulthood, focusing on the broad domains of biology, cognition, identity, affiliations and achievement (see Schulenberg et al., 1997). We provide a selective review of the empirical literature to show how these transitions relate to alcohol and other drug use.

#### *Puberty and physical development*

*Physical changes.* Pubertal development during early adolescence is characterized by a rapid acceleration in growth and the development of primary and secondary sex characteristics. By the end of high school, most adolescents have attained full adult height and reproductive capacity. Hormonal changes and societal expectations combine to increase adolescents' interest in romantic and sexual relationships (Udry, 1990) and their tolerance of alcohol (Spear, 1999). The early 20s are also when peak physical functioning occurs (e.g., heart and lung strength, athletic performance) (Arnett, 2000), making it more possible to overcome alcohol's physical effects quickly (Spear, 2000).

*Looking (and desiring to be) older.* As a result of pubertal changes, adolescents attain an increasingly adult appearance, begin to resemble cultural ideals of adult attractiveness and may be mistaken for young adults, facilitating the illegal purchase of alcohol (Wagenaar et al., 1996). Individuals (particularly girls) who mature earlier are more likely to associate with older, more deviant peers (Magnusson et al., 1986). These multiple simultaneous transitions may overload coping capacities (i.e., the Overload Model), setting the stage for increased alcohol and other drug use. Consistent with the Transition Catalyst Model, alcohol use can also be seen as an attempt to appear older (Jessor, 1992): Adolescents aware of adult status privileges including autonomy may view the ability to obtain alcohol as a desired privilege of adulthood.

#### *Cognitive development, perspective taking and decision making*

*Normative cognitive changes.* Major transformations in cognitive reasoning abilities occur during early adolescence, including increases in abstract and hypothetical thinking and the tendency to view issues as relative rather than absolute (Keating, 1990). As a result, adolescents often seem to become more argumentative as they begin to think for themselves and question authority (Smetana, 1988). Adult perceptions of reality become viewed as simply one of many possible perspectives. In addition, teens can now see themselves from the perspective of peers and are acutely aware that their own behavior may affect their image and popularity.

*Invincible and invulnerable?* Adolescents are commonly assumed to think themselves invulnerable, believing the "personal fable" that no harm will come to them (Elkind, 1967). However, research contrasting adolescent with adult decision making has not supported clear age differences in invincibility or the personal fable (e.g., Quadrel et al., 1993). Clearly, with their ability for abstraction, adolescents understand probabilities better than children and may imagine possible negative consequences of actions. How adolescents (and adults) value and weigh the relative costs and benefits of potentially risky behaviors is an area of active debate and research (Beyth-Marom and Fischhoff, 1997). For many, the decision to drink is a given, and decision making becomes centered on when, with whom and how much to drink. Such decisions may make the difference between moderate drinking and heavy drinking, and, at least theoretically, decision-making models can be useful for understanding these decisions. Practically, however, such models may have limited utility given that many alcohol use decisions occur in social groups when individuals are not sober.

*Age-related changes in alcohol outcome expectancies.* Alcohol expectancies refer to the expectations individuals have for the positive and negative outcomes of drinking alcohol. With age, adolescents become increasingly aware of potential benefits of drinking alcohol and become less convinced of costs or risks (Goldman et al., 1999; Johnson and Johnson, 1996; Maggs and Schulenberg, 1998; Miller et al., 1990). The simultaneous awareness of alcohol's costs and benefits is facilitated by an increased abstraction ability. These normative age-related changes represent a significant challenge for prevention because endorsement of positive alcohol expectancies is a powerful risk factor for alcohol use and misuse (Goldman, 1994).

*Identification of adult hypocrisy.* Children may accept blanket adult statements that alcohol is bad for people under age 21; college students often view such messages as hypocritical, especially when they conflict with common cultural behaviors. As a result, programs and messages targeted at college students need to be realistic about the

ineffectiveness of prohibition approaches. In many contexts, harm reduction approaches should be seriously considered (see e.g., Marlatt, 1998).

#### *Identity domain transitions*

Adolescents and young adults experience fundamental changes in their self-definition and identity (Erikson, 1968; Phinney and Kohatsu, 1997). Ideally, personal identity formation occurs as individuals, through exploration and commitment, develop a secure and enduring sense of self that encompasses an integrated set of personal interests, values, goals and commitments (Nurmi, 1997). Through a process of questioning previously taken-for-granted beliefs and assumptions, older adolescents actively explore alternative philosophies, behaviors and lifestyles. Although identity exploration is associated with instability in well-being, as well as with potentially health-compromising experimentation and risk taking, subsequent identity achievement predicts higher levels of well-being and a lower incidence of health-compromising behaviors (Jones, 1992).

Although identity exploration is normative and healthy, it may represent a risk factor for experimentation with risky behaviors. The role played by alcohol use in adolescents' and young adults' lives is paradoxical. Consistent with the Transition Catalyst Model, despite the possibility of serious harm, drinking also may serve important constructive functions, such as helping to make friends or to explore personal identities (Chassin et al., 1989; Jessor, 1992). As a result, some have questioned the wisdom of attempting to limit experimentation and exploration because this may leave individuals without a self-determined commitment to an identity and to personal values (e.g., Baumrind, 1987; Marcia, 1994).

#### *Affiliation domain transitions*

*Relationships with parents.* The second decade of life is a period of significant reorganization and change in family relationships (Grotevant, 1987). Normative transformations include increased autonomy and independence from parents, ideally in a context of continued support and attachment (Silverberg and Gondoli, 1996). The quantity of interaction often decreases: Older adolescents spend less time in family activities (Larson et al., 1996) and more time in contexts outside the family such as at school, with peers and at work. Despite decreases in the frequency of interaction, the quality of relationships typically improves following the physical departure of the child from the family home (e.g., Aseltine and Gore, 1993; Pipp et al., 1985). Alcohol use tends to increase as adolescents become more individuated from parents (e.g., Baer and Bray, 1999) and as parental monitoring tends to lessen (Barnes et al., 2000).

However, those who internalize positive parental norms may make wiser choices in the long term (e.g., Brody et al., 2000). During college, students continue to seek parental support and assistance in times of stress. Parent support predicts commitment to career development and persistence (Pascarella and Terenzini, 1991). Clearly, students' relationships with parents continue to play a major protective role in promoting their development and success.

*Sibling influences.* Older siblings' substance use predicts early adolescents' alcohol expectancies (D'Amico and Fromme, 1997) and subsequent substance use, above and beyond parental predictors (Duncan et al., 1996; Windle, 2000). Behavior genetic studies also suggest that, unlike many other sibling similarities and parental influences that may reflect passive genotype-environment interactions, sibling similarities in alcohol use involve important environmental effects (e.g., McGue and Sharma, 1995). Mechanisms by which siblings impact substance use may include modeling, direct social influence and access.

*Peer relationships.* Alcohol use is inextricably linked to social relationships with peers. During the college years, many social activities occur in drinking contexts, and these interactions may be facilitated by alcohol. Sociability expressed while drinking can serve as a marker of successful peer relationships and social group bonding (Newcomb and Bentler, 1988; Silbereisen and Noack, 1986). Normative age-related increases in the importance of peer relations and culture heighten exposure to cultural norms and influences that may (or may not) be compatible with the values of the family of origin (Berndt, 1992; Brown et al., 1997). Individuals who move away from home to attend college often become part of a strongly age-graded world. Many cultural myths and norms support a legendary period of partying during the first years of college. However, peer influences are not monolithic in their power or direction of influence (e.g., Brown et al., 1997). Individuals tend to seek out and be selected by peers who have similar goals, values and behaviors (Kandel et al., 1990).

At least three kinds of peer influences may serve as risk factors for increased alcohol use. First, susceptibility to peer influences increases through at least middle adolescence, making individuals more willing to go along with their peers' suggestions (e.g., Dielman, 1994; Steinberg and Silverberg, 1986). The uncertainty of adapting to a new college environment may temporarily exacerbate such tendencies (Caspi and Moffitt, 1993). Second, similarities between adolescents and their friends encourage continuity of behavior over time (Fisher and Bauman, 1988; Kandel et al., 1990). Third, perhaps due to cultural myths, students tend to significantly overestimate the prevalence of drinking on campus. Such inflated "norms" provide a not-so-subtle form of pro-drinking influence, as individuals may want to fit in with perceived group behavior (Baer and Carney, 1993; Prentice and Miller, 1993).

*Romantic and sexual relationships.* The adolescent years bring dramatic changes in sexual feelings and identity, as well as experimentation with romantic relationships and sexual behaviors. Pubertal changes provide the biological foundation for these transformations, but there are equally important cognitive, emotional, interpersonal and social antecedents as well. Brooks-Gunn and Paikoff (1993) identified four developmental challenges for adolescents in the domain of sexuality: becoming comfortable with one's maturing body, accepting feelings of sexual arousal, understanding that sexual behaviors should be mutually voluntary and practicing safe sex. Because these challenges are profoundly personal yet fundamentally relational, involving complex feelings, shared behaviors and sometimes confusing interactions with others, they are likely to remain important developmental tasks during college and beyond.

At age 18, approximately 70% of adolescents have engaged in sexual intercourse (Alan Guttmacher Institute, 1994). The majority of these have had sex with only one partner and do so relatively infrequently. Thus, many have little sexual experience, confidence or skills when they begin college. Coupled with a developmentally normative intense interest in finding a romantic partner, many students' limited sexual experience makes them likely to experience sexual situations that may be unplanned, unreciprocated or nonconsensual. Early in a relationship, safe sex may be unlikely, in part because of a lack of organization, discomfort discussing the issue and fear of implying that a partner is unhealthy.

Alcohol use may be paired with early sexual experiences in several ways. The desire to get to know potential partners may lead individuals to seek out social contexts where alcohol is served, and positive expectancies about the social and sexual enhancement properties of alcohol can increase motivations to drink (Cooper and Orcutt, 1997). Alcohol consumption in turn can make sexual behaviors in general and unsafe behaviors in particular more likely by reducing inhibitions, giving courage and providing an "excuse" for getting wild (Dermen et al., 1998).

Just as new intimate relationships can increase alcohol use, the transition into more committed relationships, such as marriage or even engagement, can decrease it (Leonard and Rothbard, 1999). Indeed, this general "marriage effect" appears to explain normative age-related decreases in alcohol and other drug use (Bachman et al., 1997).

#### *Achievement domain transitions*

Adolescents and young adults face a series of major educational and/or occupational transitions. Successful adaptation to and performance in educational and occupational domains is healthy development. The acquisition of knowledge, critical thought and practical skills helps define concurrent and future optimal development (Clausen, 1991).

In contrast, difficulties in negotiating these critical transitions can contribute to cumulative and emergent health risks.

*School transitions.* Before college, adolescents typically experience transitions to middle school and high school. Embedded in these formal contextual changes are more gradual and subtle alterations, including spending the day with one teacher to moving between classrooms with specialized instructors (Eccles et al., 1993). Postsecondary education takes these shifts further, to classes in multiple buildings with large groups of students, taught by specialized instructors who may not know each other, let alone the students.

The majority of American adolescents attend some form of postsecondary education. College attendance greatly improves lifetime occupational prospects and earnings and, when attended full time, also postpones adult roles such as full-time worker, spouse and parent (Marini, 1987). An extended passage toward adulthood can have many noneducational benefits, including an opportunity to learn, explore ideas and pursue personal and academic interests (Pascarella and Terenzini, 1991). Likewise, individuals can experiment with various behaviors, values and lifestyles. In other words, the college experience can provide a safe haven for exploration, a developmental moratorium (Arnett, 2000; Sherrod et al., 1993).

Transitions to new educational settings require major adaptations that may be stressful but also provide opportunities for a fresh start (Aseltine and Gore, 1993; Eccles et al., 1993; Sher et al., 1996). Thus it is a time of both vulnerability and growth (Compas et al., 1986). Just as the transition to college engenders important changes in students' relationships with their families of origin, peers and romantic partners, it brings dramatic increases in autonomy. For example, for the first time, students have the legal right to privacy of their academic records. As a result of the 1977 federal Family Educational Rights Privacy Act, colleges can release only very limited information about students' educational records even to the students' parents. Recent amendments, however, permit the release of information about alcohol and drug violations for those under age 21.

Cultural norms promote heavy drinking as a rite of passage during the undergraduate years (Prentice and Miller, 1993). Films show large groups of students living together, partying and having a great time. Reputations of campuses as "party" schools are passed formally (e.g., via college guides) and informally among social networks. The desire to make new friends and to participate in the mythical college experience may lead to socially motivated heavy drinking (Transition Catalyst Model) (Cooper et al., 1998; Maggs, 1997). Finally, the stressful aspects of adapting to a new social world and heavier academic demands may also promote alcohol use to help students relax (Overload Model) (Windle, 1992).



*Work transitions.* Paid work is another major achievement transition. During high school, working more hours is associated with higher levels of use of alcohol and other drugs (e.g., Bachman and Schulenberg, 1993; Greenberger and Steinberg, 1986; Mortimer et al., 1996). There is considerable disagreement about the causal direction between work hours and substance use, with one partial explanation involving "third variables" (e.g., disengagement from school) that contribute to increased work intensity and substance use (Bachman and Schulenberg, 1993). Nevertheless, work hours appear to be causally related to increased alcohol use among adolescents (Mortimer et al., 1996). Potential explanations relate to the Overload Model (e.g., stress of balancing long work hours with other activities) and the Developmental Mismatch Model (e.g., most adolescent jobs do not provide developmentally appropriate experiences).

Although part-time work is common during college, little empirical work has examined the relation between work intensity and substance use during college. To the extent that part-time work contributes to additional stress (i.e., the Overload Model), alcohol and other drug use would be expected to increase. In contrast, to the extent that part-time work provides a good match with course work and desired career path (i.e., the Developmental Mismatch Model), substance use might decrease as a function of work.

The transition from school to full-time work is associated with declines in substance use (Bachman et al., 1997; Wood et al., 2000), although this is less true for high school students who go directly to full-time work (Schulenberg et al., 2000). This transition is one defining feature of the transition to adulthood with its concomitant changes in responsibilities, freedoms and contexts. Although this transition is associated with decreased substance use, this decline appears to be impacted more by the transition into marriage (Bachman et al., 1997).

### **Implications for Research and Intervention**

#### *Developmental research on substance use etiology and intervention*

Multiwave, contextually sensitive longitudinal research is essential for gaining a fuller understanding of substance use etiology and intervention (Eddy et al., 1998; Loeber and Farrington, 1994; Schulenberg et al., 2001b). Such data permit researchers to consider complex mediational and reciprocal models linking risk and protective factors with substance use over time (Curran and Muthén, 1999; Rutter, 1994; Windle and Davies, 1999) as well as to identify different (often nonlinear) trajectories of substance use onset and change (Babor et al., 1992; Cloninger, 1987; Zucker, 1987). Short-term, intensive repeated-measures data are valuable for examining processes linking proximal influences such as the transition into college, concurrent risk

factors and substance use. Long-term multiwave panel data are essential for understanding how distal influences relate to proximal ones (e.g., how childhood and adolescent risk and protective factors relate to alcohol and other drug use during college).

A developmental perspective emphasizes the importance of taking a long view on intervention effects (Maggs et al., 1997). Positive short-term effects are important, and enduring salutary effects on developmental trajectories are especially important. Often no measurable improvement in behavior is visible at the conclusion of a preventive intervention (Dielman, 1994), indicating the need for continued assessment, as minor alterations in the slope of a trajectory can result in consequential changes as they accumulate over many years (Kellam and Rebok, 1992; Maggs and Schulenberg, 2001). Long-term intervention research provides opportunities to test etiological theories by altering the constellation of risk factors and observing whether hypothesized changes occur (Coie et al., 1993; Dishion et al., 1999; Kellam and Rebok, 1992; Maggs and Schulenberg, 1998).

#### *Programs and policies regarding college drinking*

Developmental transitions represent windows of opportunity for effecting change. These naturally occurring periods of disequilibrium can be utilized to try to divert previously established risky trajectories and encourage healthy habits, skills and relationships. In this section, we offer a selective list of program and policy implications to help illustrate how developmental considerations can and should come into play when attempting to reduce college drinking. When appropriate, we make reference to intervention implications that follow from the five conceptual models discussed earlier (see Table 1).

*Facilitate developmental transitions.* Going off to college reflects several important developmental transitions in the identity, affiliation and achievement domains. To the extent that difficulties with these transitions contribute to increased alcohol and other drug use, then efforts to assist in successfully negotiating the transitions should translate into less substance use (Schulenberg et al., 2001b). Consistent with the Overload Model, preparing young people in advance of entering college and providing support during the many transitions should serve to increase coping capacities to deal with the stress of multiple simultaneous transitions. Consistent with the Developmental Mismatch Model, ensuring a good match between a young person's expectations about college and what the college experience can actually provide would be beneficial as well. Successful adaptations to transitions are fundamental aspects of development. Although some transitions can be difficult, it is through such challenges that individuals grow, acquiring advanced characteristics competencies. Gaining a better

understanding of how the world works, broader access to social support and greater control over one's social context will likely increase one's ability to avoid or alter detrimental behaviors.

*Intervene at the level of the context and the individual-context match.* Following from the developmental contextual perspective, interventions aimed at altering the context can yield salutary changes in individuals (Maggs et al., 1997). Examples of contextual targets for alcohol intervention include changing social norms (e.g., perceived acceptability of heavy drinking), altering laws and penalties for violations (e.g., legislative changes for parental notification), changing marketing practices (e.g., server training) and providing substance-free housing (e.g., Bennett et al., 1992; Grossman et al., 1994; Perkins et al., 1999; Wechsler et al., 2001). Consistent with the Developmental Mismatch Model, broader-based contextual interventions that attempt to increase the match between individuals and their contexts (e.g., career apprenticeship programs) might also prove effective in reducing heavy drinking and other risky behaviors.

*Balance increased freedoms with increased responsibilities.* A defining feature of human growth is the quest for increased mastery over oneself and the environment (e.g., Harter, 1999; Heckhausen, 1999). This quest requires a balance of increased freedoms and responsibilities, as too much of either can thwart the progression of mastery. Once at college, students may suddenly have more personal freedom than responsibility, and more peers in the same situation, thus providing an opportunity for casual substance use to be transformed into frequent heavy use. Consistent with the Developmental Mismatch Model, the social role ambiguity and transience of this period in life may discourage commitment to social conventions and implicitly encourage heavy drinking by creating an imbalance of increased personal freedoms without parallel social responsibilities. Possible solutions include slowing the pace of increased freedoms (e.g., dorm curfews for first-year students), increasing social responsibilities through community work (see Youniss and Yates, 1997) and involving students in campus governance and discipline.

*Interventions should be varied and developmentally relevant.* Developmentally relevant interventions take into account what is known about normative developmental changes and concerns of a given population. As a group, college students have unique needs simultaneously to build social lives, form romantic and sexual attachments, maintain positive relationships with their families of origin, succeed academically, decide on and progress toward a career and manage their complex daily lives. Thus simple upward extensions of high school prevention efforts are less likely to be effective, whereas programs that incorporate how college students see drinking problems and possible solutions are more likely to be effective. Likewise, consistent with

the Transition Catalyst Model (where drinking is viewed as facilitating transitions), high-quality diversion programs that provide numerous and varied alternatives to drinking for meeting social, romantic and stress-reduction goals are likely to prove effective.

Consistent with the Increased Heterogeneity Model, students with extensive substance use histories before college may be at risk for greater adjustment difficulties in general (e.g., Chassin et al., 1999a). They are unlikely to be influenced by standard prevention efforts, suggesting the need for more intensive targeted interventions (e.g., Darkes and Goldman, 1993). In contrast, for college students on a developmentally limited trajectory of heavy drinking, adjustment problems may be neither a cause nor a consequence of their heavy drinking, and intensive personal interventions may prove counterproductive; instead, high-quality diversion programs or harm-reduction approaches may prove effective (Marlatt et al., 1995).

*Reduce negative consequences of heavy drinking.* Systematic broad-based programs and policy changes may eventually be effective in decreasing the rates of heavy drinking among the nation's college students, and specific campuses may be able to effect more localized change. Nevertheless, given that heavy drinking tends to be culturally embedded in the transition to young adulthood in general, and the college experience in particular, it is unlikely that we will see large reductions in national rates in the short term. This underscores the importance of attempting to reduce the negative consequences of heavy drinking (i.e., harm reduction) (Marlatt et al., 1995). Following from the Transition Catalyst Model, risk taking plays an essential role in identity formation (Baumrind, 1987) and in negotiating peer-related and other developmental transitions (Brown et al., 1997; Chassin et al., 1989). Consistent with the Heightened Vulnerability to Chance Events Model, an adaptive strategy in negotiating the transition to college is to explore one's new contexts and one's identity in relation to the new contexts, a strategy that tends to increase the odds of unpredicted events. Therefore, it is essential to provide students with strategies for successfully managing risky behaviors and negotiating chance encounters with accompanying potential negative consequences.

## Conclusion

For most students, heavy drinking and associated problems tend to peak during college amid the abundance of explicit and subtle expectations and opportunities to drink and then to subside as they move into adulthood roles. This normative shift is quite remarkable: In a few short years, the excessive drinking and concomitant negative consequences experienced by many students that would likely reflect diagnosable alcohol misuse (and often alcohol dependence) at other points in the life span simply run their

course and stop. For other students, heavy drinking becomes troublesome and tragic. By understanding how alcohol and other drug use fits in young people's lives, and specifically how it is embedded in their numerous developmental transitions, we can have a stronger foundation for understanding etiology and for effecting positive change.

### Acknowledgments

The authors thank Patrick Johnson, Robert Zucker and the other members of the Subcommittee Panel for their comments and suggestions on initial versions of this article. We also thank Jeffrey Arnett, Alison Bryant and Deborah Safron for their comments and suggestions, and also Tanya Hart, Virginia Laetz, Patti Meyer and Crystal Pickett for their editorial and production assistance.

### References

- ALAN GUTTMACHER INSTITUTE. *Sex and America's Teenagers*, New York: Alan Guttmacher Institute, 1994.
- ANDERSSON, T. Developmental patterns and the dynamics of alcohol problems in adolescence and young adulthood. In: BERGMAN, L.R., CAIRNS, R.B., NILSSON, L.G. AND NYSTEDT, L. (Eds.) *Developmental Science and the Holistic Approach*, Mahwah, NJ: Lawrence Erlbaum, 2000, pp. 377-391.
- ARNETT, J.J. Emerging adulthood: A theory of development from the late teens through the twenties. *Amer. Psychol.* **55**: 469-480, 2000.
- ASELTINE, R.H. AND GORE, S. Mental health and social adaptation following the transition from high school. *J. Res. Adolesc.* **3**: 247-270, 1993.
- BABOR, T.F., HOFMANN, M., DELBOCA, F.K., HESSELBROCK, V.M., MEYER, R.E., DOLINSKY, Z.S. AND ROUNSAVILLE, B. Types of alcoholics: I. Evidence for an empirically derived typology based on indicators of vulnerability and severity. *Arch. Gen. Psychiat.* **49**: 599-608, 1992.
- BACHMAN, J.G. AND SCHULENBERG, J. How part-time work intensity relates to drug use, problem behavior, time use, and satisfaction among high school seniors: Are these consequences or merely correlates? *Devel. Psychol.* **29**: 220-235, 1993.
- BACHMAN, J.G., WADSWORTH, K.N., O'MALLEY, P.M., JOHNSTON, L.D. AND SCHULENBERG, J.E. *Smoking, Drinking, and Drug Use in Young Adulthood: The Impacts of New Freedoms and New Responsibilities*, Mahwah, NJ: Lawrence Erlbaum, 1997.
- BAER, J.S. Etiology and secondary prevention of alcohol problems with young adults. In: BAER, J.S., MARLATT, G.A. AND MCMAHON, R.J. (Eds.) *Addictive Behaviors Across the Life Span: Prevention, Treatment, and Policy Issues*, Thousand Oaks, CA: Sage, 1993, pp. 111-137.
- BAER, J.S. AND CARNEY, M.M. Biases in the perceptions of the consequences of alcohol use among college students. *J. Stud. Alcohol* **54**: 54-60, 1993.
- BAER, P.E. AND BRAY, J.H. Adolescent individuation and alcohol use. *J. Stud. Alcohol, Supplement No. 13*, pp. 52-62, 1999.
- BALTES, P.B. Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Devel. Psychol.* **23**: 611-626, 1987.
- BANDURA, A. The psychology of chance encounters and life paths. *Amer. Psychol.* **37**: 747-755, 1982.
- BARNES, G.M., REIFMAN, A.S., FARRELL, M.P. AND DINTCHEFF, B.A. The effects of parenting on the development of adolescent alcohol misuse: A six-wave latent growth model. *J. Marr. Fam.* **62**: 175-186, 2000.
- BATES, M.E. AND LABOUVIE, E.W. Personality-environment constellations and alcohol use: A process-oriented study of intraindividual change during adolescence. *Psychol. Addict. Behav.* **9**: 23-35, 1995.
- BATES, M.E. AND LABOUVIE, E.W. Adolescent risk factors and the prediction of persistent alcohol and drug use into adulthood. *Alcsm Clin. Exp. Res.* **21**: 944-950, 1997.
- BAUMRIND, D. A developmental perspective on adolescent risk taking in contemporary America. In: IRWIN, C.E., JR. (Ed.) *Adolescent Social Behavior and Health*, San Francisco, CA: Jossey-Bass, 1987, pp. 93-125.
- BENEDICT, R. *Patterns of Culture*, New York: New American Library, 1950.
- BENNETT, P., MURPHY, S. AND BUNTON, R. Preventing alcohol problems using healthy public policy. *Hlth Prom. Int.* **7**: 297-306, 1992.
- BERNDT, T.J. Friendship and friends' influence in adolescence. *Curr. Direct. Psychol. Sci.* **1** (5): 156-159, 1992.
- BEYTH-MAROM, R. AND FISCHHOFF, B. Adolescents' decisions about risks: A cognitive perspective. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 110-135.
- BLANE, H.T. Middle-aged alcoholics and young drinkers. In: BLANE, H.T. AND CHAFETZ, M.E. (Eds.) *Youth, Alcohol, and Social Policy*, New York: Plenum Press, 1979, pp. 5-38.
- BRODY, G.H., GE, X., KATZ, J. AND ARIAS, I. A longitudinal analysis of internalization of parental alcohol-use norms and adolescent alcohol use. *Appl. Devel. Sci.* **4** (2): 71-79, 2000.
- BRONFENBRENNER, U. *The Ecology of Human Development: Experiments by Nature and Design*, Cambridge, MA: Harvard Univ. Press, 1979.
- BROOK, J.S., COHEN, P., WHITEMAN, M. AND GORDON, A.S. Psychosocial risk factors in the transition from moderate to heavy use or abuse of drugs. In: GLANTZ, M. AND PICKENS, R. (Eds.) *Vulnerability to Drug Abuse*, Washington, DC: American Psychological Assn, 1992, pp. 359-388.
- BROOK, J.S., KESSLER, R.C. AND COHEN, P. The onset of marijuana use from preadolescence and early adolescence to young adulthood. *Devel. Psychopathol.* **11**: 901-914, 1999.
- BROOKS-GUNN, J. AND PAIKOFF, R. "Sex is a gamble, kissing is a game": Adolescent sexuality and health promotion. In: MILLSTEIN, S.G., PETERSEN, A.C. AND NIGHTINGALE, E.O. (Eds.) *Promoting the Health of Adolescents: New Directions for the Twenty-First Century*, New York: Oxford Univ. Press, 1993, pp. 180-208.
- BROWN, B.B., DOLCINI, M.M. AND LEVENTHAL, A. Transformations in peer relationships at adolescence: Implications for health-related behavior. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 161-189.
- CAIRNS, R.B. AND CAIRNS, B.D. *Lifelines and Risks: Pathways of Youth in Our Time*, New York: Cambridge Univ. Press, 1994.
- CAIRNS, R.B., CAIRNS, B.D., RODKIN, P. AND XIE, H. New directions in developmental research: Models and methods. In: JESSOR, R. (Ed.) *New Perspectives on Adolescent Risk Behavior*, New York: Cambridge Univ. Press, 1998, pp. 13-40.
- CANTOR, N. AND LANGSTON, C.A. Ups and downs of life tasks in a life transition. In: PERVIN, L.A. (Ed.) *Goal Concepts in Personality and Social Psychology*, Mahwah, NJ: Lawrence Erlbaum, 1989, pp. 127-167.
- CASPI, A., ELDER, G.H. AND BEM, D.J. Moving away from the world: Life-course patterns of shy children. *Devel. Psychol.* **24**: 824-831, 1988.
- CASPI, A. AND MOFFITT, T.E. When do individual differences matter? A paradoxical theory of personality coherence. *Psychol. Inq.* **4** (4): 247-271, 1993.
- CHASSIN, L., PITTS, S.C. AND DELUCIA, C. The relation of adolescent substance use to young adult autonomy, positive activity involvement, and perceived competence. *Devel. Psychopathol.* **11**: 915-932, 1999a.
- CHASSIN, L., PITTS, S.C., DELUCIA, C. AND TODD, M. A longitudinal study of children of alcoholics: Predicting young adult substance use disorders, anxiety, and depression. *J. Abnorm. Psychol.* **108**: 106-119, 1999b.
- CHASSIN, L., PRESSON, C.C. AND SHERMAN, S.J. "Constructive" vs. "destructive" deviance in adolescent health-related behaviors. *J. Youth Adolesc.* **18**: 245-262, 1989.
- CICCHETTI, D. A developmental psychopathology perspective on drug abuse. In: GLANTZ, M.D. AND HARTEL, C.R. (Eds.) *Drug Abuse: Origins &*

- Interventions, Washington, DC: American Psychological Assn, 1999, pp. 97-117.
- CICCHETTI, D. AND ROGOSCH, F.A. Equifinality and multifinality in developmental psychopathology. *Devel. Psychopathol.* **8**: 597-600, 1996.
- CLAUSEN, J.A. Adolescent competence and the shaping of the life course. *Amer. J. Sociol.* **96**: 805-842, 1991.
- CLAYTON, R.R. Transitions in drug use: Risk and protective factors. In: GLANTZ, M. AND PICKENS, R. (Eds.) *Vulnerability to Drug Abuse*, Washington, DC: American Psychological Assn, 1992, pp. 15-51.
- CLONINGER, C.R. Neurogenetic adaptive mechanisms and alcoholism. *Science* **236**: 410-416, 1987.
- CLONINGER, C.R., SVRAKIC, N.M. AND SVRAKIC, D.M. Role of personality self-organization in development of mental order and disorder. *Devel. Psychopathol.* **9**: 881-906, 1997.
- COIE, J.D., WATT, N.F., WEST, S.G., HAWKINS, J.D., ASARNOW, J.R., MARKMAN, H.J., RAMEY, S.L., SHURE, M.B. AND LONG, B. The science of prevention: A conceptual framework and some directions for a national research program. *Amer. Psychol.* **48**: 1013-1022, 1993.
- COLEMAN, J.C. The focal theory of adolescence: A psychological perspective. In: HURRELMANN, K. AND ENGEL, U. (Eds.) *The Social World of Adolescents: International Perspectives*, New York: Walter de Gruyter, 1989, pp. 43-56.
- COMPAS, B.E., WAGNER, B.M., SLAVIN, L.A. AND VANNATTA, K. A prospective study of life events, social support, and psychological symptomatology during the transition from high school to college. *Amer. J. Commun. Psychol.* **14**: 241-257, 1986.
- COOPER, M.L. AND ORCUTT, H.K. Drinking and sexual experience on first dates among adolescents. *J. Abnorm. Psychol.* **106**: 191-202, 1997.
- COOPER, M.L., SHAPIRO, C.M. AND POWERS, A.M. Motivations for sex and risky sexual behavior among adolescents and young adults: A functional perspective. *J. Pers. Social Psychol.* **75**: 1528-1558, 1998.
- CROCKETT, L.J. AND CROUTER, A.C. (Eds.) *Pathways through Adolescence: Individual Development in Relation to Social Contexts*, Mahwah, NJ: Lawrence Erlbaum, 1995.
- CURRAN, P.J. AND MUTHÉN, B.O. The application of latent curve analysis to testing developmental theories in intervention research. *Amer. J. Commun. Psychol.* **27**: 567-595, 1999.
- D'AMICO, E.J. AND FROMME, K. Health risk behaviors of adolescent and young adult siblings. *Hlth Psychol.* **16**: 426-432, 1997.
- DAMPHOUSSE, K.R. AND KAPLAN, H.B. Intervening processes between adolescent drug use and psychological distress: An examination of the self-medication hypothesis. *Social Behav. Pers.* **26**: 115-130, 1998.
- DARKES, J. AND GOLDMAN, M.S. Expectancy challenge and drinking reduction: Experimental evidence for a mediational process. *J. Cons. Clin. Psychol.* **61**: 344-353, 1993.
- DERMEN, K.H., COOPER, M.L. AND AGOCHA, V.B. Sex-related alcohol expectancies as moderators of the relationship between alcohol use and risky sex in adolescents. *J. Stud. Alcohol* **59**: 71-77, 1998.
- DIELMAN, T.E. School-based research on the prevention of adolescent alcohol use and misuse: Methodological issues and advances. *J. Res. Adolesc.* **4**: 271-293, 1994.
- DISHON, T.J., McCORD, J. AND POULIN, F. When interventions harm: Peer groups and problem behavior. *Amer. Psychol.* **54**: 755-764, 1999.
- DONOVAN, J.E., JESSOR, R. AND JESSOR, L. Problem drinking in adolescence and young adulthood: A follow-up study. *J. Stud. Alcohol* **44**: 109-137, 1983.
- DOUVAN, E. AND ADELSON, J. *The Adolescent Experience*, New York: John Wiley & Sons, 1966.
- DUNCAN, T.E., DUNCAN, S.C. AND HOPS, H. The role of parents and older siblings in predicting adolescent substance use: Modeling development via structural equation latent growth methodology. *J. Fam. Psychol.* **10**: 158-172, 1996.
- ECCLES, J.S., MIDGLEY, C., WIGFIELD, A., BUCHANAN, C.M., REUMAN, D., FLANAGAN, C. AND MACIVER, D. Development during adolescence: The impact of stage-environment fit on young adolescents' experiences in schools and in families. *Amer. Psychol.* **48**: 90-101, 1993.
- EDDY, J.M., DISHON, T.J. AND STOOLMILLER, M. The analysis of intervention change in children and families: Methodological and conceptual issues embedded in intervention studies. *J. Abnorm. Child Psychol.* **26**: 53-69, 1998.
- ELDER, G.H., JR. The life course and human development. In: DAMON, W. (Series Ed.) and LERNER, R.M. (Vol. Ed.) *Handbook of Child Psychology*, Vol. 1: *Theoretical Models of Human Development*, New York: John Wiley & Sons, 1998, pp. 939-991.
- ELKIND, D. Egocentrism in adolescence. *Child Devel.* **38**: 1025-1034, 1967.
- ELLICKSON, P.L. AND HAYS, R.D. Antecedents of drinking among young adolescents with different alcohol use histories. *J. Stud. Alcohol* **52**: 398-408, 1991.
- ERIKSON, E.H. *Identity, Youth and Crisis*, New York: W.W. Norton, 1968.
- FILLMORE, K.M., JOHNSTONE, B.M., LEINO, E.V. AND AGER, C.R. A cross-study contextual analysis of effects from individual-level drinking and group-level drinking factors: A meta-analysis of multiple longitudinal studies from the Collaborative Alcohol-Related Longitudinal Project. *J. Stud. Alcohol* **54**: 37-47, 1993.
- FISHER, L.A. AND BAUMAN, K.E. Influence and selection in the friend-adolescent relationship: Findings from studies of adolescent smoking and drinking. *J. Appl. Social Psychol.* **18** (4, Pt 2): 289-314, 1988.
- FREUD, A. Adolescence. *Psychoanal. Study Child* **13**: 255-278, 1958.
- GALAMBOS, N.L. AND EHRENBERG, M.F. The family as health risk and opportunity: A focus on divorce and working families. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 139-160.
- GARMEZY, N., MASTEN, A.S. AND TELLEGEN, A. The study of stress and competence in children: A building block for developmental psychopathology. *Child Devel.* **55**: 97-111, 1984.
- GLANTZ, M.D., WEINBERG, N.Z., MINER, L.L. AND COLLIVER, J.D. The etiology of drug abuse: Mapping the paths. In: GLANTZ, M.D. AND HARTEL, C.R. (Eds.) *Drug Abuse: Origins & Interventions*, Washington, DC: American Psychological Assn, 1999, pp. 3-45.
- GOLDMAN, M.S. The alcohol expectancy concept: Applications to assessment, prevention, and treatment of alcohol abuse. *Appl. Prev. Psychol.* **3** (3): 131-144, 1994.
- GOLDMAN, M.S., DEL BOCA, F.K. AND DARKES, J. Alcohol expectancy theory: The application of cognitive neuroscience. In: LEONARD, K.E. AND BLANE, H.T. (Eds.) *Psychological Theories of Drinking and Alcoholism*, New York: Guilford Press, 1999, pp. 203-246.
- GORE, S., ASELTINE, R., JR., COLTEN, M.E. AND LIN, B. Life after high school: Development, stress, and well-being. In: GOTLIB, I.H. AND WHEATON, B. (Eds.) *Stress and Adversity Over the Life Course: Trajectories and Turning Points*, New York: Cambridge Univ. Press, 1997, pp. 197-214.
- GRABER, J.A., BROOKS-GUNN, J. AND GALEN, B.R. Betwixt and between: Sexuality in the context of adolescent transitions. In: JESSOR, R. (Ed.) *New Perspectives on Adolescent Risk Behavior*, New York: Cambridge Univ. Press, 1998, pp. 270-316.
- GREENBERGER, E. AND STEINBERG, L. *When Teenagers Work: The Psychological and Social Costs of Adolescent Employment*, New York: Basic Books, 1986.
- GROSSMAN, M., CHALOUKPA, F.J., SAFFER, H. AND LAIXUTHAI, A. Effects of alcohol price policy on youth: A summary of economic research. *J. Res. Adolesc.* **4**: 347-364, 1994.
- GROTEVANT, H.D. Toward a process model of identity formation. *J. Adolesc. Res.* **2**: 203-222, 1987.
- GUO, J., COLLINS, L.M., HILL, K.G. AND HAWKINS, J.D. Developmental pathways to alcohol abuse and dependence in young adulthood. *J. Stud. Alcohol* **61**: 799-808, 2000.

- HALL, G.S. *Adolescence: Its Psychology and its Relation to Physiology, Anthropology, Sociology, Sex, Crime, Religion, and Education*, Upper Saddle River, NJ: Prentice Hall, 1904.
- HARTER, S. *The Construction of the Self: A Developmental Perspective*, New York: Guilford Press, 1999.
- HAVIGHURST, R.J. *Developmental Tasks and Education*, 2nd Edition, New York: Longmans, Green, 1952.
- HAWKINS, J.D., CATALANO, R.F. AND MILLER, J.Y. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychol. Bull.* **112**: 64-105, 1992.
- HECKHAUSEN, J. *Developmental Regulation in Adulthood: Age-Normative and Sociostructural Constraints as Adaptive Challenges*, New York: Cambridge Univ. Press, 1999.
- HOPS, H., DAVIS, B. AND LEWIN, L.M. The development of alcohol and other substance use: A gender study of family and peer context. *J. Stud. Alcohol, Supplement No. 13*, pp. 22-31, 1999.
- HUSSONG, A.M. AND CHASSIN, L. Substance use initiation among adolescent children of alcoholics: Testing protective factors. *J. Stud. Alcohol* **58**: 272-279, 1997.
- JACKSON, K.M., SHER, K.J., GOTHAM, H.J., AND WOOD, P.K. Transitioning into and out of large-effect drinking in young adulthood. *J. Abnorm. Psychol.* **110**: 378-391, 2001.
- JESSOR, R. Risk behavior in adolescence: A psychosocial framework for understanding and action. *Devel. Rev.* **12**: 374-390, 1992.
- JESSOR, R., DONOVAN, J.E. AND COSTA, F.M. *Beyond Adolescence: Problem Behavior and Young Adult Development*, New York: Cambridge Univ. Press, 1991.
- JESSOR, R. AND JESSOR, S.L. *Problem Behavior and Psychological Development: A Longitudinal Study of Youth*, San Diego, CA: Academic Press, 1977.
- JOHNSON, P.B. AND JOHNSON, H.L. Children's beliefs about the social consequences of drinking and refusing to drink alcohol. *J. Alcohol Drug Educ.* **41** (3): 34-43, 1996.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *Monitoring the Future: National Survey Results on Drug Use, 1975-2000, Vol. 1*, NIH Publication No. 01-4924, Bethesda, MD: Department of Health and Human Services, 2001a.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *Monitoring the Future: National Survey Results on Drug Use, 1975-2001, Vol. 2*, NIH Publication No. 01-4925, Washington, Government Printing Office, 2001b.
- JONES, R.M. Ego identity and adolescent problem behavior. In: ADAMS, G.R., GULLOTTA, T.P. AND MONTEMAYOR, R. (Eds.) *Adolescent Identity Formation*, Vol. 4, Thousand Oaks, CA: Sage, 1992, pp. 216-233.
- KANDEL, D.B., DAVIES, M. AND BAYDAR, N. The creation of interpersonal contexts: Homophily in dyadic relationships in adolescence and young adulthood. In: ROBINS, L.N. AND RUTTER, M. (Eds.) *Straight and Deviant Pathways from Childhood to Adulthood*, New York: Cambridge Univ. Press, 1990, pp. 221-241.
- KANDEL, D.B. AND RAVEIS, V.H. Cessation of illicit drug use in young adulthood. *Arch. Gen. Psychiat.* **46**: 109-116, 1989.
- KAZDIN, A.E. Adolescent mental health: Prevention and treatment programs. *Amer. Psychol.* **48**: 127-141, 1993.
- KEATING, D.P. Adolescent thinking. In: FELDMAN, S.S. AND ELLIOTT, G.R. (Eds.) *At the Threshold: The Developing Adolescent*, Cambridge, MA: Harvard Univ. Press, 1990, pp. 54-89.
- KELLAM, S.G. AND REBOK, G.W. Building developmental and etiological theory through epidemiologically based preventive intervention trials. In: MCCORD, J. AND TREMBLAY, R.E. (Eds.) *Preventing Antisocial Behavior: Interventions from Birth through Adolescence*, New York: Guilford Press, 1992, pp. 162-195.
- LARSON, R.W., RICHARDS, M.H., MONETA, G., HOLMBECK, G. AND DUCKETT, E. Changes in adolescents' daily interactions with their families from ages 10 to 18: Disengagement and transformation. *Devel. Psychol.* **32**: 744-754, 1996.
- LEONARD, K.E. AND ROTHBARD, J.C. Alcohol and the marriage effect. *J. Stud. Alcohol, Supplement No. 13*, pp. 139-146, 1999.
- LENER, R.M. Children and adolescents as producers of their own development. *Devel. Rev.* **2**: 342-370, 1982.
- LENER, R.M. AND GALAMBOS, N.L. Adolescent development: Challenges and opportunities for research, programs, and policies. *Annual Rev. Psychol.* **49**: 413-446, 1998.
- LOEBER, R. The stability of antisocial and delinquent child behavior: A review. *Child Devel.* **53**: 1431-1446, 1982.
- LOEBER, R. AND FARRINGTON, D.P. Problems and solutions in longitudinal and experimental treatment studies of child psychopathology and delinquency. *J. Cons. Clin. Psychol.* **62**: 887-900, 1994.
- LONCZAK, H.S., HUANG, B., CATALANO, R.F., HAWKINS, J.D., HILL, K.G., ABBOTT, R.D., RYAN, J.A. AND KOSTERMAN, R. The social predictors of adolescent alcohol misuse: A test of the social development model. *J. Stud. Alcohol* **62**: 179-189, 2001.
- MCGUE, M. AND SHARMA, A. Parent and sibling influences on adolescent alcohol use and misuse: Evidence from a U.S. adoption cohort. *J. Stud. Alcohol* **57**: 8-18, 1995.
- MACKINNON, D.P. Analysis of mediating variables in prevention and intervention research. In: CÁZARES, A. AND BEATTY, L.A. (Eds.) *Scientific Methods for Prevention Intervention Research*, NIDA Monograph No. 139, NIH Publication No. 94-3631, Washington: Government Printing Office, 1994, pp. 127-154.
- MAGGS, J.L. Alcohol use and binge drinking as goal-directed action during the transition to postsecondary education. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 345-371.
- MAGGS, J.L. AND SCHULENBERG, J. Reasons to drink and not to drink: Altering trajectories of drinking through an alcohol misuse prevention program. *Appl. Devel. Sci.* **2** (1): 48-60, 1998.
- MAGGS, J.L. AND SCHULENBERG, J. Editors' introduction: Prevention as altering the course of development and the complementary purposes of developmental and prevention sciences. *Appl. Devel. Sci.* **5**: 196-200, 2001.
- MAGGS, J.L., SCHULENBERG, J. AND HURRELMANN, K. Developmental transitions during adolescence: Health promotion implications. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 522-546.
- MAGNUSSON, D., STATTIN, H. AND ALLEN, V. Differential maturation among girls and its relations to social adjustment in a longitudinal perspective. In: BALTES, P.B., FEATHERMAN, D. AND LERNER, R. (Eds.) *Life Span Development and Behavior*, Vol. 7, Mahwah, NJ: Lawrence Erlbaum, 1986, pp. 136-172.
- MARCIA, J.E. Identity and psychotherapy. In: ARCHER, S.L. (Ed.) *Interventions for Adolescent Identity Development*, Thousand Oaks, CA: Sage, 1994, pp. 29-46.
- MARINI, M.M. Measuring the process of role change during the transition to adulthood. *Social Sci. Res.* **16**: 1-38, 1987.
- MARLATT, G.A. (Ed.) *Harm Reduction: Pragmatic Strategies for Managing High Risk Behaviors*, New York: Guilford Press, 1998.
- MARLATT, G.A., BAER, J.S. AND LARIMER, M. Preventing alcohol abuse in college students: A harm-reduction approach. In: BOYD, G.M., HOWARD, J. AND ZUCKER, R.A. (Eds.) *Alcohol Problems among Adolescents: Current Directions in Prevention Research*, Mahwah, NJ: Lawrence Erlbaum, 1995, pp. 147-172.
- MARSHAL, M.P. AND CHASSIN, L. Peer influence on adolescent alcohol use: The moderating role of parental support and discipline. *Appl. Devel. Sci.* **4** (2): 80-88, 2000.
- MEAD, M. *Coming of Age in Samoa*, New York: New American Library, 1950.

- MILLER, P.M., SMITH, G.T. AND GOLDMAN, M.S. Emergence of alcohol expectancies in childhood: A possible critical period. *J. Stud. Alcohol* **51**: 343-349, 1990.
- MOFFITT, T.E. Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychol. Rev.* **100**: 674-701, 1993.
- MOFFITT, T.E., CASPI, A., DICKSON, N., SILVA, P. AND STANTON, W. Childhood-onset versus adolescent-onset antisocial conduct problems in males: Natural history from ages 3 to 18 years. *Devel. Psychopathol.* **8**: 399-424, 1996.
- MORTIMER, J.T., FINCH, M.D., RYU, S., SHANAHAN, M.J. AND CALL, K.T. The effects of work intensity on adolescent mental health, achievement, and behavioral adjustment: New evidence from a prospective study. *Child Devel.* **67**: 1243-1261, 1996.
- MUTHÉN, B.O. AND MUTHÉN, L.K. The development of heavy drinking and alcohol-related problems from ages 18 to 37 in a U.S. national sample. *J. Stud. Alcohol* **61**: 290-300, 2000.
- MUUS, R.E. *Theories of Adolescence*, 6th Edition, New York: Random House, 1996.
- NATIONAL INSTITUTE ON ALCOHOL ABUSE AND ALCOHOLISM (NIAAA). Tenth Special Report to the U.S. Congress on Alcohol and Health: Highlights from Current Research, NIH Publication No. 00-1583, Bethesda, MD: Department of Health and Human Services, 2000, pp. 28-53.
- NEUGARTEN, B.L. Time, age, and the life cycle. *Amer. J. Psychiat.* **136**: 887-894, 1979.
- NEWCOMB, M.D. Psychosocial predictors and consequences of drug use: A developmental perspective within a prospective study. *J. Addict. Dis.* **16**: 51-89, 1997.
- NEWCOMB, M.D. AND BENTLER, P.M. Impact of adolescent drug use and social support on problems of young adults: A longitudinal study. *J. Abnorm. Psychol.* **97**: 64-75, 1988.
- NURMI, J.E. Adolescent development in an age-graded context: The role of personal beliefs, goals, and strategies in the tackling of developmental tasks and standards. *Int. J. Behav. Devel.* **16**: 169-189, 1993.
- NURMI, J.E. Self-definition and mental health during adolescence and young adulthood. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 395-419.
- OETTING, E.R. AND BEAUVAIS, F. Peer cluster theory: Drugs and the adolescent. *J. Counsel. Devel.* **65**: 17-22, 1986.
- PANDINA, R.J., LABOUIE, E.W., JOHNSON, V. AND WHITE, H.R. The relationship between alcohol and marijuana use and competence in adolescence. *J. Hlth Social Policy* **1** (3): 89-108, 1990.
- PASCARELLA, E.T. AND TEREZINI, P.T. *How College Affects Students: Findings and Insights from Twenty Years of Research*, San Francisco, CA: Jossey-Bass, 1991.
- PATTERSON, G.R., DEBARYSHE, B.D. AND RAMSEY, E. A developmental perspective on antisocial behavior. *Amer. Psychol.* **44**: 329-335, 1989.
- PERKINS, H.W., MEILMAN, P.W., LEICHLITER, J.S., CASHIN, J.R. AND PRESLEY, C.A. Misperceptions of the norms for the frequency of alcohol and other drug use on college campuses. *J. Amer. Coll. Hlth* **47**: 253-258, 1999.
- PETERSEN, A.C. Presidential address: Creating adolescents: The role of context and process in developmental trajectories. *J. Res. Adolesc.* **3**: 1-18, 1993.
- PETERSEN, A.C. AND LEFFERT, N. What is special about adolescence? In: RUTTER, M. (Ed.) *Psychosocial Disturbances in Young People: Challenges for Prevention*, New York: Cambridge Univ. Press, 1995, pp. 3-36.
- PETRAITIS, J., FLAY, B.R. AND MILLER, T.Q. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. *Psychol. Bull.* **117**: 67-86, 1995.
- PHINNEY, J.S. AND KOHATSU, E.L. Ethnic and racial identity development and mental health. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 420-443.
- PIPP, S., SHAVER, P., JENNINGS, S., LAMBORN, S. AND FISCHER, K. Adolescents' theories about the development of their relationships with their parents. *J. Pers. Social Psychol.* **48**: 991-1001, 1985.
- PLOMIN, R., DEFRIES, J.C. AND LOEHLIN, J.C. Genotype-environment interaction and correlation in the analysis of human behavior. *Psychol. Bull.* **84**: 309-322, 1977.
- PRENTICE, D.A. AND MILLER, D.T. Pluralistic ignorance and alcohol use on campus: Some consequences of misperceiving the social norm. *J. Pers. Social Psychol.* **64**: 243-256, 1993.
- QUADREL, M.J., FISCHHOFF, B. AND DAVIS, W. Adolescent (in)vulnerability. *Amer. Psychol.* **48**: 102-116, 1993.
- RUTTER, M. Isle of Wight revisited: Twenty-five years of child psychiatric epidemiology. *J. Amer. Acad. Child Adolesc. Psychiat.* **28**: 633-653, 1989.
- RUTTER, M. Beyond longitudinal data: Causes, consequences, changes, and continuity. *J. Cons. Clin. Psychol.* **62**: 928-940, 1994.
- RUTTER, M. Transitions and turning points in developmental psychopathology: As applied to the age span between childhood and mid-adulthood. *Int. J. Behav. Devel.* **19**: 603-626, 1996.
- SAMEROFF, A.J. The social context of development. In: EISENBERG, N. (Ed.) *Contemporary Topics in Developmental Psychology*, New York: John Wiley & Sons, 1987, pp. 273-291.
- SCARR, S. AND MCCARTNEY, K. How people make their own environments: A theory of genotype-environment effects. *Child Devel.* **54**: 424-435, 1983.
- SCHLEGEL, A. AND BARRY, H., 3RD. *Adolescence: An Anthropological Inquiry*, New York: Free Press, 1991.
- SCHULENBERG, J. Binge drinking trajectories before, during, and after college: More reasons to worry from a developmental perspective. Invited paper presented at the NIAAA preconference session: *Adolescence and Alcohol: Implications for College Drinking*. Conference of the American Psychological Society, Denver, CO, June 1999.
- SCHULENBERG, J. AND MAGGS, J.L. *A Developmental Perspective on Substance Use During Adolescence and the Transition to Young Adulthood, Monitoring the Future Occasional Paper No. 51*, Ann Arbor, MI: Institute for Social Research, 2001.
- SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. Negotiating developmental transitions during adolescence and young adulthood: Health risks and opportunities. In: SCHULENBERG, J., MAGGS, J.L. AND HURRELMANN, K. (Eds.) *Health Risks and Developmental Transitions during Adolescence*, New York: Cambridge Univ. Press, 1997, pp. 1-19.
- SCHULENBERG, J., MAGGS, J.L., LONG, S.W., SHER, K.J., GOTHAM, H.J., BAER, J.S., KIVLAHAN, D.R., MARLATT, G.A. AND ZUCKER, R.A. The problem of college drinking: Insights from a developmental perspective. *Alcsm Clin. Exp. Res.* **25**: 473-477, 2001a.
- SCHULENBERG, J., MAGGS, J.L., STEINMAN, K. AND ZUCKER, R.A. Development matters: Taking the long view on substance abuse etiology and intervention during adolescence. In: MONTI, P.M., COLBY, S.M. AND O'LEARY, T.A. (Eds.) *Adolescents, Alcohol, and Substance Abuse: Reaching Teens through Brief Interventions*, New York: Guilford Press, 2001b, pp. 19-57.
- SCHULENBERG, J., O'MALLEY, P.M., BACHMAN, J.G. AND JOHNSTON, L.D. "Spread your wings and fly": The course of well-being and substance use during the transition to young adulthood. In: CROCKETT, L.J. AND SILBEREISEN, R.K. (Eds.) *Negotiating Adolescence in Times of Social Change*, New York: Cambridge Univ. Press, 2000, pp. 224-255.
- SCHULENBERG, J., O'MALLEY, P.M., BACHMAN, J.G., WADSWORTH, K.N. AND JOHNSTON, L.D. Getting drunk and growing up: Trajectories of frequent binge drinking during the transition to young adulthood. *J. Stud. Alcohol* **57**: 289-304, 1996a.
- SCHULENBERG, J., WADSWORTH, K.N., O'MALLEY, P.M., BACHMAN, J.G. AND JOHNSTON, L.D. Adolescent risk factors for binge drinking during the

- transition to young adulthood: Variable- and pattern-centered approaches to change. *Devel. Psychol.* **32**: 659-674, 1996b.
- SHAVER, P., FURMAN, W. AND BUHRMESTER, D. Transition to college: Network changes, social skills, and loneliness. In: DUCK, S. AND PERLMAN, D. (Eds.) *Understanding Personal Relationships: An Interdisciplinary Approach*. Thousand Oaks, CA: Sage, 1985, pp. 193-219.
- SHER, K.J. *Children of Alcoholics: A Critical Appraisal of Theory and Research*. Chicago, IL: Univ. of Chicago Press, 1991.
- SHER, K.J., TRULL, T.J., BARTHOLOW, B.D. AND VIETH, A. Personality and alcoholism: Issues, methods, and etiological processes. In: LEONARD, K.E. AND BLANE, H.T. (Eds.) *Psychological Theories of Drinking and Alcoholism*, 2nd Edition, New York: Guilford Press, 1999, pp. 54-105.
- SHER, K.J., WOOD, P.K. AND GOTHAM, H.J. The course of psychological distress in college: A prospective high-risk study. *J. Coll. Student Devel.* **37**: 42-51, 1996.
- SHERROD, L.R., HAGGERTY, R.J. AND FEATHERMAN, D.L. Introduction: Late adolescence and the transition to adulthood. *J. Res. Adolesc.* **3**: 217-226, 1993.
- SILBEREISEN, R.K., EYFERTH, K. AND RUDINGER, G. (Eds.) *Development as Action in Context: Problem Behavior and Normal Youth Development*, New York: Springer-Verlag, 1986.
- SILBEREISEN, R.K. AND NOACK, P. On the constructive role of problem behavior in adolescence. In: BOLGER, N., CASPI, A., DOWNEY, G. AND MOOREHOUSE, E.M. (Eds.) *Persons in Context: Developmental Processes*, New York: Cambridge Univ. Press, 1986, pp. 152-180.
- SILVERBERG, S.B. AND GONDOLI, D.M. Autonomy in adolescence: A contextual perspective. In: ADAMS, G.R., MONTEMAYOR, R. AND GULLOTTA, T. (Eds.) *Psychosocial Development during Adolescence*, Thousand Oaks, CA: Sage, 1996, pp. 12-61.
- SIMMONS, R.G. AND BLYTH, D.A. *Moving into Adolescence: The Impact of Pubertal Change and School Context*, New York: Aldine de Gruyter, 1987.
- SMETANA, J.G. Concepts of self and social convention: Adolescents' and parents' reasoning about hypothetical and actual family conflicts. In: GUNNAR, M.R. AND COLLINS, W.A. (Eds.) *Development during the Transition to Adolescence: Minnesota Symposia on Child Psychology*, Vol. 21, Mahwah, NJ: Lawrence Erlbaum, 1988, pp. 79-122.
- SPEAR, L.P. Adolescent period: Biological basis of vulnerability to develop alcoholism and other ethanol-mediated behaviors. Invited paper presented at the NIAAA preconference session: Adolescence and Alcohol: Implications for College Drinking. Conference of the American Psychological Society, Denver, CO, June 1999.
- SPEAR, L. Modeling adolescent development and alcohol use in animals. *Alcohol Hlth Res. World* **24**: 115-123, 2000.
- STEINBERG, L. AND SILVERBERG, S.B. The vicissitudes of autonomy in early adolescence. *Child Devel.* **57**: 841-851, 1986.
- STRAUS, R. AND BACON, S.D. *Drinking in College*, New Haven, CT: Yale Univ. Press, 1953.
- TARTER, R.E. AND VANYUKOV, M. Alcoholism: A developmental disorder. *J. Cons. Clin. Psychol.* **62**: 1096-1107, 1994.
- UDRY, J.R. Hormonal and social determinants of adolescent sexual initiation. In: BANCROFT, J. AND REINISCH, J.M. (Eds.) *Adolescence and Puberty*, New York: Oxford Univ. Press, 1990, pp. 70-87.
- WACHS, T.D. Necessary but Not Sufficient: The Respective Roles of Single and Multiple Influences on Individual Development, Washington, DC: American Psychological Assn, 2000.
- WAGENAAR, A.C., TOOMEY, T.L., MURRAY, D.M., SHORT, B.J., WOLFSON, M. AND JONES-WEBB, R. Sources of alcohol for underage drinkers. *J. Stud. Alcohol* **57**: 325-333, 1996.
- WEBER, M.D., GRAHAM, J.W., HANSEN, W.B., FLAY, B.R. AND JOHNSON, C.A. Evidence for two paths of alcohol use onset in adolescents. *Addict. Behav.* **14**: 399-408, 1989.
- WECHSLER, H., DOWDALL, G.W., MAENNER, G., GLEDHILL-HOYT, J. AND LEE, H. Changes in binge drinking and related problems among American college students between 1993 and 1997: Results of the Harvard School of Public Health College Alcohol Study. *J. Amer. Coll. Hlth* **47**: 57-68, 1998.
- WECHSLER, H., LEE, J.E., NELSON, T.F. AND LEE, H. Drinking levels, alcohol problems, and secondhand effects in substance-free residences: Results of a national study. *J. Stud. Alcohol* **62**: 23-31, 2001.
- WILLS, T.A. AND HIRKY, A.E. Coping and substance abuse: A theoretical model and review of the evidence. In: ZEIDNER, M. AND ENDLER, N.S. (Eds.) *Handbook of Coping: Theory, Research, Applications*, New York: John Wiley & Sons, 1996, pp. 279-302.
- WILSNACK, S.C. Alcohol use and alcohol problems in women. In: STANTON, A.L. AND GALLANT, S.J. (Eds.) *The Psychology of Women's Health: Progress and Challenges in Research and Application*, Washington, DC: American Psychological Assn, 1995, pp. 381-443.
- WINDLE, M. A longitudinal study of stress buffering for adolescent problem behaviors. *Devel. Psychol.* **28**: 522-530, 1992.
- WINDLE, M. Parental, sibling, and peer influences on adolescent substance use and alcohol problems. *Appl. Devel. Sci.* **4**: 98-110, 2000.
- WINDLE, M. AND DAVIES, P.T. Developmental theory and research. In: LEONARD, K.E. AND BLANE, H.T. (Eds.) *Psychological Theories of Drinking and Alcoholism*, 2nd Edition, New York: Guilford Press, 1999, pp. 164-202.
- WOOD, M.D., SHER, K.J., AND MCGOWAN, A.K. Collegiate alcohol involvement and role attainment in early adulthood: Findings from a prospective high-risk study. *J. Stud. Alcohol* **61**: 278-289, 2000.
- YOUNISS, J. AND YATES, M. *Community Service and Social Responsibility in Youth*, Chicago, IL: Univ. of Chicago Press, 1997.
- ZIRKEL, S. Developing independence in a life transition: Investing the self in the concerns of the day. *J. Pers. Social Psychol.* **62**: 506-521, 1992.
- ZUCKER, R.A. The four alcoholisms: A developmental account of the etiology process. In: RIVERS, P.C. (Ed.) *Alcohol and Addictive Behavior*. (Nebraska Symposium on Motivation 1986, Vol. 34), Lincoln, NE: Univ. of Nebraska Press, 1987, pp. 27-83.
- ZUCKER, R.A., FITZGERALD, H.E. AND MOSES, H.D. Emergence of alcohol problems and the several alcoholisms: A developmental perspective on etiology theory and life course trajectory. In: CICCHETTI, D. AND COHEN, D.J. (Eds.) *Developmental Psychopathology*, Vol. 2: Risk, Disorder, and Adaptation, New York: John Wiley & Sons, 1995, pp. 677-711.

# The Adolescent Brain and the College Drinker: Biological Basis of Propensity to Use and Misuse Alcohol\*

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**ABSTRACT.** *Objective:* This article reviews the literature on adolescent brain development and considers the impact of these neural alterations on the propensity to use and misuse alcohol. *Method:* Neural, behavioral and hormonal characteristics of adolescents across a variety of species were examined, along with a review of the ontogeny of ethanol responsiveness, tolerance development and stress/alcohol interactions. *Results:* The adolescent brain is a brain in transition. Prominent among the brain regions undergoing developmental change during adolescence in a variety of species are the prefrontal cortex and other fore-brain dopamine projection regions, stressor-sensitive areas that form part of the neural circuitry modulating the motivational value of alcohol and other reinforcing stimuli. Along with these characteristic brain features, adolescents also exhibit increased stressor responsivity and an altered sensitivity to a variety of ethanol effects. Findings are mixed to date as

to whether exposure to ethanol during this time of rapid brain development alters neurocognitive function and later propensity for problematic ethanol use. *Conclusions:* Developmental transformations of the adolescent brain may have been evolutionarily advantageous in promoting behavioral adaptations to avoid inbreeding and to facilitate the transition to independence. These brain transformations may also alter sensitivity of adolescents to a number of alcohol effects, leading perhaps in some cases to higher intakes to attain reinforcing effects. These features of the adolescent brain may also increase the sensitivity of adolescents to stressors, further escalating their propensity to initiate alcohol use. Additional investigations are needed to resolve whether ethanol use during adolescence disrupts maturational processes in ethanol-sensitive brain regions. (*J. Stud. Alcohol*, Supplement No. 14: 71-81, 2002)

**T**O NEGOTIATE with success the developmental transition from youth to maturity, adolescents of many species must survive the risks and stresses of this passage while obtaining the skills necessary for independence. Although certain attributes of human adolescents are unique and not evident in other species, other characteristic features are expressed by adolescents of diverse species and may have been evolutionarily adaptive in helping adolescents conquer this critical transition.

## Characteristics of Adolescence in Humans and Other Animals

The process of adolescence is not synonymous with puberty. Adolescence includes the entire transition from childhood to adulthood; puberty is a more discrete phase during which the physiological and neuroendocrine alterations associated with sexual maturation occur. Puberty is only one of the ontogenetic alterations occurring during adolescence, with the timing of this phase within the broader framework of adolescence varying notably among human adolescents (e.g., Dubas, 1991).

The temporal boundaries of adolescence are elusive. It is difficult in any species to characterize when the first transition of adolescence begins to emerge and the last rem-

nant still persists. In humans, adolescence is commonly defined as the second decade of life (Petersen et al., 1996), with ages up to 25 years considered late adolescence by some researchers (Baumrind, 1987). In rats, commonly cited times for the onset of adolescence are postnatal days 28-32 (P28-32), with offsets between P38-55 (e.g., Ojeda and Urbanski, 1994), although this timing is somewhat disputed (Odell, 1990) and may depend on growth rate (Kennedy and Mitra, 1963). Spear and Brake (1983) operationally defined "periadolescence" as the age period around the time of sexual maturation when age-specific behavioral and psychopharmacological discontinuities were evident. Using this criterion, the age period of approximately P28-42 in rats was conservatively designated as periadolescence, with animals of this age showing numerous neurobehavioral alterations from significantly younger (pre- or postweanling) animals as well as more mature (P60 and older) animals. Adolescence in monkeys typically occurs in the age range of 2-4 years (see Lewis, 1997).

## Hormonal concomitants of adolescence

Puberty represents a reactivation, after a prolonged period of suppression during the childhood/juvenile period, of pulsatile release of gonadotropin-releasing hormone that was evident perinatally. This reinstatement of pulsatile release of gonadotropin-releasing hormone induces pulsed release of follicle-stimulating hormone and luteinizing hormone, which in turn stimulate release of gonadal hormones

\*Preparation of this article was supported in part by National Institute on Alcohol Abuse and Alcoholism grants R37 AA12525 and R01 QQ12150.



(e.g., testosterone in males and estrogen in females) (e.g., Brooks-Gunn and Reiter, 1990). Pulsatile release of growth hormone also increases more than 10-fold during the growth spurt of adolescence (Gabriel et al., 1992). Surprisingly, many of the characteristic behavioral features of adolescence discussed below do not seem to be associated in any simple fashion with puberty-related increases in gonadal hormones (e.g., Susman et al., 1987), but rather may be driven largely by maturational changes in the nervous system (reviewed in a later section; see also Spear, 2000).

### *Behavioral characteristics of adolescence*

Adolescents of a variety of species differ behaviorally from younger and older individuals on a number of dimensions consistent with a developmental trajectory toward the goal of independence. Adolescent rats exhibit increases in exploration and novelty seeking relative to other aged rats (e.g., Spear et al., 1980; for review, see Spear, 2000). They also spend more time in social interactions with conspecifics (Fassino and Campbell, 1981; Primus and Kellogg, 1989). Sex differences in behavior also begin to emerge in adolescence, with some of these differences being driven in part by organizational influences of pubertal hormones (e.g., Beatty and Fessler, 1977; Brand and Slob, 1988). Human adolescents likewise exhibit increases in social behavior (Csikszentmihalyi et al., 1977), as well as a disproportionate amount of reckless behavior, sensation seeking and risk taking relative to individuals at other ages (Arnett, 1992). Together such age-related modifications in behavior are consistent with the need of the adolescent to explore novel domains and establish new social relationships during the process of achieving parental independence. Across most mammalian species, adolescence is associated with emigration of male and/or female adolescents away from the natal group into unknown territory, a strategy thought to have been evolutionarily advantageous for species to avoid the detrimental effects of inbreeding (e.g., see Schlegel and Barry, 1991).

Adolescents also seemingly exhibit age-related alterations in the way they respond to motivational stimuli. Human adolescents exhibit an increase in negative affect and depressed mood relative to younger or older individuals (e.g., Larson and Asmussen, 1991). In addition to greater negative affect, adolescents seemingly experience and expect to experience positive situations as less pleasurable than younger or older individuals. Between late childhood and adolescence, the number of reports of feeling happy drops by 50%; even when engaged in the same activities, adolescents find them less pleasurable than do adults (Larson and Richards, 1994). Thus human adolescents appear to show some degree of anhedonia, seeming to attain less positive impact from stimuli with moderate to low incentive value. As a consequence, adolescents may be predisposed to pur-

sue new appetitive reinforcers through increases in risk taking and novelty-seeking behaviors, including alcohol and drug use.

In animal studies, adolescents also have been shown to exhibit characteristic alterations in psychopharmacological sensitivity suggestive of a temporary hyposensitivity of one or more dopamine (DA) systems during adolescence. For example, adolescent rats are less sensitive than their younger or older counterparts to the acute stimulatory effects of catecholaminergic agonists such as amphetamine and cocaine, but conversely are more sensitive to the DA antagonist haloperidol (for references and discussion, see Spear and Brake, 1983). Indeed, alterations in mesocorticolimbic DA systems are a particular hallmark of the adolescent brain, as discussed in the next section.

### *Neural alterations during adolescence*

The adolescent brain is unique and in a state of transition as it undergoes both progressive and regressive changes (for review, see Spear, 2000). One brain region prominently altered during adolescence across a variety of species is the prefrontal cortex, an area thought to subservise higher cognitive abilities such as the bridging of temporal delays in memory (e.g., Diamond, 1991). For example, absolute prefrontal cortex volume declines in adolescence in humans (Jernigan et al., 1991) as well as in rats (van Eden et al., 1990). Substantial synapse elimination occurs during adolescence in the prefrontal cortex and other cortical regions in humans (Huttenlocher, 1984) and in nonhuman primates (Zecevic et al., 1989). At least a portion of this synapse elimination in the prefrontal cortex appears to be associated with the marked developmental loss of presumed glutaminergic excitatory input (Zecevic et al., 1989). In contrast, DA input to the prefrontal cortex in nonhuman primates increases during adolescence to peak at levels well above those seen earlier or later in life (Rosenberg and Lewis, 1994; for review, see Lewis, 1997). Increases in prefrontal cortex DA input through adolescence are also evident in rats (Kalsbeek et al., 1988). Cholinergic innervation of the prefrontal cortex likewise increases in adolescence to reach mature levels in rats (Gould et al., 1991) and humans (Kostovic, 1990).

Maturational changes during adolescence are also evident in other brain regions such as the hippocampus of rodents (Dumas and Foster, 1998; Wolfer and Lipp, 1995) and humans (Benes, 1989). Alterations evident in the hypothalamus include qualitative differences in norepinephrine (NE) release evident in adolescents relative to younger or older rats, along with pharmacological alterations consistent with the suggested emergence in adolescence of inhibitory alpha-2 NE autoreceptors (Choi and Kellogg, 1992; Choi et al., 1997).

Dopaminergic systems undergo substantial reorganization during adolescence. More than one-third to one-half of the DA D<sub>1</sub> and D<sub>2</sub> receptors present in the striatum of juveniles are lost by adulthood in both humans (Seeman et al., 1987) and rats (Gelbard et al., 1989; Teicher et al., 1995). This peak in D<sub>1</sub> and D<sub>2</sub> binding during adolescence and subsequent decline is much more pronounced in the striatum than in the nucleus accumbens (Teicher et al., 1995) and in male rats than in female rats (Andersen et al., 1997b). Not all DA receptors show this overproduction and pruning, with juveniles having only 40% of adult-typical DA D<sub>3</sub> receptor levels in striatal and accumbens regions (Stanwood et al., 1997). The DA transporter likewise undergoes a protracted period of development in mesolimbic and mesocortical brain regions, with only about 70% of adult uptake levels being seen prior to adolescence onset in rats (Coulter et al., 1996).

Developmental events during adolescence may alter the relative balance of DA activity between the prefrontal cortex and striatal or mesolimbic terminal regions, resulting in a greater predominance of DA activity in the prefrontal cortex during early adolescence. As mentioned previously, DA input to the prefrontal cortex increases during adolescence in nonhuman primates (Rosenberg and Lewis, 1994) and rats (Kalsbeek et al., 1988). Basal DA synthesis peaks in rat prefrontal cortex early in adolescence and subsequently wanes, while synthesis is low at this time in nucleus accumbens and subsequently increases (Andersen et al., 1997a). Similar data are obtained from estimates of DA turnover (Teicher et al., 1993). Interestingly, although the prefrontal cortex is seemingly devoid of synthesis-modulating autoreceptors in adulthood (e.g., Galloway et al., 1986), convincing evidence has been obtained for a transient expression of DA autoreceptor-like modulation of DA synthesis in the prefrontal cortex early in life that disappears during adolescence (Andersen et al., 1997a; Teicher et al., 1991).

A shift in the balance of DA activity from the nucleus accumbens to the prefrontal cortex early in adolescence would seemingly result in a relative DA deficiency at this time in the accumbens, a mesolimbic brain region critical for modulating the salience of various incentive stimuli, including alcohol and other drugs of misuse (e.g., Koob, 1992). Functional DA deficits in the accumbens and related mesolimbic brain regions have been linked to a reward deficiency syndrome. Individuals with this syndrome have been postulated to “actively seek out not only addicting drugs but also environmental novelty and sensation as a type of behavioral remediation of reward deficiency” (Gardner, 1999, p. 82). It remains to be determined whether adolescents, because of age-related shifts in the balance of DA activity among mesocorticolimbic brain regions, might show a transient “reward deficiency syndrome” that is milder although qualitatively similar to that hypothesized to be

characteristic of abstinent drug users and other at-risk adults. Consistent with this speculation is evidence (previously discussed) that human adolescents show signs of anhedonia, as well as findings that adolescent animals exhibit a reduced sensitivity to certain effects of drugs such as alcohol when compared with their adult counterparts (see discussion below).

Clearly, the brain of the adolescent is in transition. Neural regions showing prominent alterations during adolescence include the prefrontal cortex as well as other forebrain DA projection regions. Given the importance of these brain areas in modulating reward efficacy of reinforcing drugs (Koob, 1992), sensitivity to the environment and stressors (e.g., Dunn and Kramarcy, 1984) and the association between the two (e.g., Goeders, 1997; Piazza et al., 1991), it is not surprising that adolescents vary notably from more mature animals in their responsivity to ethanol, stressors and their interaction, as discussed in the sections below.

### **Ontogeny of Responsivity to Ethanol**

#### *Prevalence of alcohol use in adolescents*

In the 2000 Monitoring the Future Survey of the National Institute on Drug Abuse (Johnston et al., 2001), 43% of 8th graders, 65% of 10th graders and 73% of high school seniors reported that they had used alcohol in the past year. About 8% of 8th graders, 24% of 10th graders and 32% of 12th graders also reported getting drunk on one or more occasions during the past month. Clearly, many adolescents use alcohol, with evidence of excessive use emerging in some individuals.

Adolescents are not immune to the development of dependence and may exhibit a variety of alcohol dependence symptoms, including evidence of ethanol tolerance, escalated patterns of use and difficulty in cutting down or quitting (Pollock and Martin, 1999). Once adolescents become dependent on alcohol, their rates of relapse approximate those of alcoholic adults, despite the much shorter chronicity of alcohol use in the adolescent (Brown, 1993). Escalation of alcohol use may be unusually rapid during adolescence. Compared with individuals initiating drug use in adulthood, adolescent-onset individuals had “accelerated dependency courses, with shorter times from first exposure to dependence for alcohol and cannabis and shorter times between their first and second dependencies” (Clark et al., 1998, p. 120).

Adolescent rats display two to three times higher levels of ethanol intake relative to their body weights than do more mature animals (Brunell et al., 2001; Lancaster et al., 1996), although ethanol preference per se does not peak until well into adulthood (around 5 months of age [Goodrick, 1967; Parisella and Pritham, 1964]). The notably different ontogenetic conclusions reached when using gram-per-

kilogram intake versus percentage of total fluid to index ethanol consumption seemingly reflect ontogenetic differences in total fluid consumption, with adolescent rats exhibiting greater overall fluid (and food) consumption than adults. Indeed, during the adolescent growth spurt, caloric intake relative to body weight is greater than at any other time in the life span (e.g., Nance, 1983). Adolescent humans also exhibit elevated metabolic activity and developmental hyperphagia (e.g., Ganji and Betts, 1995; Post and Kemper, 1993), with heavy alcohol use often being "adolescence-limited" (e.g., Bates and Labouvie, 1997).

The elevated consummatory patterns of adolescence could contribute to high levels of ethanol intake by these growing individuals relative to their body weight. As discussed below, adolescents might be able to sustain comparatively large ethanol intakes due to their relative insensitivity to the sedative and locomotor incoordinating effects of ethanol, which may be in part related to their greater propensity to develop acute and functional tolerance relative to more mature organisms.

#### *Acute responsivity to alcohol*

Studies using a variety of measures in laboratory animals have observed increases in ethanol sensitivity from infancy through adolescence and into adulthood, with further increases in sensitivity during the aging process (e.g., York and Chan, 1993). This early insensitivity to many ethanol effects is evident despite slower rates of ethanol metabolism in younger animals (e.g., Silveri and Spear, 2000; Zorzano and Herrera, 1989) and is evident using measures such as lethal dose (Hollstedt and Rydberg, 1985), motor impairment (Hollstedt et al., 1980; Moy et al., 1998), hypothermia (Silveri and Spear, 2001; Spiers and Fusco, 1991), anxiolytic effects (Varlinskaya and Spear, 2001) and ethanol-induced hypnosis (Ernst et al., 1976; Little et al., 1996; Silveri and Spear, 1998). These findings, however, are not ubiquitous (e.g., Keir and Deitrich, 1990).

Whether a similar insensitivity to various ethanol effects is evident prior to maturity in humans is unknown, with research in this area limited by ethical constraints. Even if it were possible to conduct controlled studies of ethanol responsivity in children and adolescents, interpretation of across-age data would be complicated by issues such as history of prior use, ethanol tolerance and intoxicated practice effects. On the one hand, it could be argued that an adolescent insensitivity to ethanol effects would be inconsistent with the high incidence of morbidity and mortality during adolescence (Irwin and Millstein, 1992) due in part to risk behaviors involving alcohol use (e.g., drinking and driving) (Donovan, 1993). On the other hand, a relative insensitivity to ethanol effects could contribute to the high incidence of heavy episodic drinking among adolescents. In the year 2000 data from the Monitoring the Fu-

ture Study, 14.1% of 8th graders, 26.2% of 10th graders and 30.0% of 12th graders reported drinking five or more drinks in a row within the past 2 weeks. Surprisingly, these percentages at the two younger ages were higher than those reporting drunkenness, with only 8.3% of 8th graders and 23.5% of 10th graders indicating that they were drunk on one or more occasions during the past month (comparable data for 12th graders was 32.3%). To the extent that these data are accurate, fewer young to mid-adolescents reported being drunk than drinking five or more drinks in a row, findings consistent with a relative insensitivity to ethanol intoxication among younger adolescents when compared with more mature individuals. Alternatively, these survey data could reflect inflation of alcohol consumption or inaccuracies in perception or reporting of intoxication among younger adolescents.

Although studies using animal models have documented that adolescents are resistant to many ethanol effects, they are conversely more sensitive to certain restricted effects of ethanol—specifically ethanol-induced disruptions of hippocampal plasticity and memory. Swartzwelder et al. (1995a,b) found that hippocampal slices from preadolescent (P15-25) rats were more sensitive than adult slices to ethanol disruption of both N-methyl-D-aspartate (NMDA)-mediated excitation as well as stimulus-induced long-term potentiation. Behaviorally, P30 adolescent rats were found to be more impaired than adult rats by ethanol in a hippocampally related spatial memory task in the Morris maze, whereas nonspatial performance was unaffected by ethanol at either age (Markwiese et al., 1998). Somewhat similar age-related memory disruptions by ethanol have been reported in humans, with early postadolescent (21- to 24-year old) adults showing more ethanol-induced disruption of memory acquisition on both semantic and figural memory tasks than slightly older (25- to 29-year old) individuals (Acheson et al., 1998). Thus, although reduced sensitivity to motor impairing, anxiolytic and sedative consequences of ethanol (see above) may permit adolescents to consume greater amounts of ethanol, this exposure may have more adverse effects on hippocampally related memory processing than later in life.

Taken together, the animal data show that the mosaic of behavioral sensitivities to different ethanol effects vary between adolescents and adults, with adolescents showing greater sensitivity to ethanol-induced impairments of cognitive performance and long-term potentiation, but less sensitivity to ethanol-related sedative, motor impairment and anxiolytic effects. These divergent patterns of sensitivities may represent differential development of neural systems underlying different cognitive and behavioral consequences of ethanol. For example, although ethanol-induced disruption of spatial memory appears to be linked to developmental changes in hippocampal glutamate/NMDA systems (see Swartzwelder et al., 1995a,b), developmental immatu-

rity in brain gamma-aminobutyric acid (GABA) systems rather than ontogenetic alterations in NMDA systems appears to contribute in part to the lower sensitivity of adolescent animals to the sedative effects of ethanol (Moy et al., 1998; Silveri and Spear, in press).

#### *Tolerance development*

Differential sensitivity to various ethanol effects between adolescents and adults may also be attributable in part to possible ontogenetic differences in the capacity to develop ethanol tolerance. For example, the resistance of young organisms to ethanol's hypnotic effects has been shown to be related in part to the tolerance that develops within a given ethanol exposure period. This form of within-session tolerance is called acute tolerance and is very prevalent early in life, declining to reach adult levels only during late adolescence (Silveri and Spear, 1998). This ontogenetic decline may be specific to acute tolerance, with forms of tolerance that emerge only following repeated ethanol exposures showing different ontogenetic patterns. For example, Silveri and Spear (1999) reported that preweanling and adolescent rats showed no evidence of rapid tolerance (tolerance developing with 24-48 hours after repeated ethanol exposures) to ethanol-induced sleep, whereas such tolerance was evident in adults. On the other hand, following multiple ethanol exposures, adolescents have been reported to exhibit more chronic tolerance to ethanol-induced hypothermia than adult rats (Swartzwelder et al., 1998). The sometimes greater propensity for adolescent animals to develop these compensatory adaptations to ethanol may contribute to their relative resistance to many ethanol effects relative to their more mature counterparts. Yet it remains to be determined whether similar adaptations would be evident in human adolescents. Empirical research of this nature would be difficult to conduct given ethical constraints on exposing human children and adolescents to ethanol even on a single occasion, let alone repeatedly.

### **Stress, Adolescence and Alcohol Misuse**

#### *Stress and adolescence*

Navigating the developmental transition toward independence is often stressful for human adolescents, and indeed adolescents appear to experience a greater number of negative life events than preadolescents (Larson and Asmussen, 1991). In addition to the actual frequency of life stressors possibly being greater in adolescence than at other ages, adolescents may also respond differently to stress than individuals at other ages. This perhaps should not be surprising, given that stressors selectively activate many of the neural systems undergoing developmental change during adolescence (for review, see Spear, 2000), including

mesocorticolimbic DA projections implicated in modulating the reward value of drugs (Dunn and Kramarcy, 1984).

In general, adolescents appear to respond with greater negative affect to circumstances in their environment than do children and adults (Larson and Richards, 1994). They also typically find the circumstances of their lives to be more anxiety provoking and stressful. For example, using electronic diaries to monitor moods and certain behaviors of 14-year olds, Whalen et al. (2001) found that even adolescents who scored low on externalizing and depression measures reported feeling anxious more than one-third of the time and stressed about 25% of the time.

In behavioral studies with laboratory animals, adolescents often have been observed to be more susceptible to stressors than adults. For example, adolescent rats show more stress-induced immobility during forced swim testing (Walker et al., 1995) or in the presence of intermittent foot-shock (Campbell et al., in preparation) than do adults. As another example, Stone and Quartermain (1997) found that chronic exposure to social stress (placement in the cage of an isolated adult male for 5 minutes daily for 5 days) or a daily period of restraint stress had a greater impact on adolescent mice (P28-32) than on adult male mice, suppressing food intake and body weight gain in adolescents but not adults. In this study, the chronic social stress was also observed to increase anxiety (indexed by a suppression of time spent on the open arms of an elevated plus maze) in the adolescents but not the adult mice.

Exposure to a stressor activates the hypothalamic-pituitary-adrenal (HPA) axis, resulting in a cascading sequence of hormone release from the hypothalamus (corticotropin-releasing factor), pituitary (adrenocorticotropic hormone [ACTH]) and adrenals (corticosterone in rats; cortisol in humans). Whereas some research has reported that there are developmental increases in HPA activity through adolescence in humans (Kiess et al., 1995), the ontogeny of stress-induced activation of the HPA system and associated neurobehavioral consequences has been most systematically examined in laboratory animals. Peak ACTH and corticosterone responses to stress generally increase during ontogeny to reach an asymptote in rats around adolescence, at least in males (Bailey and Kitchen, 1987; Meaney et al., 1985a; Ramaley and Olson, 1974; Rivier, 1989; Walker et al., 1986). Adolescent rats have also been reported to exhibit more prolonged stress-induced increases in corticosterone than adults (Choi and Kellogg, 1996; Goldman et al., 1973; Sapolsky et al., 1985). This delayed poststress recovery presumably reflects immature feedback regulation mediated in part by glucocorticoid receptors in the hippocampus (e.g., Meaney et al., 1985a,b). Thus adolescence may be associated with a greater overall corticoid response to stress, with this stress-induced increase being elevated relative to younger animals and prolonged relative to adults.

Although little explored, the nervous system also appears to respond differently to stressors during adolescence than at younger or older ages. For example, Choi and Kellogg (1996) observed a blunted hypothalamic NE response to stress in late adolescent rats (P42), a transition between the increased stress-related NE utilization seen in early adolescence (P28) and the decreased utilization seen in adulthood. A similar adolescent transitional period was seen in terms of autonomic reactivity to stressor stimuli in the peripheral nervous system. Whereas preweanling rat pups exhibited heart rate bradycardia to an aversive stimulus, heart rate tachycardia emerged by adolescence, with this increased heart rate mediated by parasympathetic withdrawal in adolescents but primarily by sympathetic activation in adults (Kurtz and Campbell, 1994).

Thus, along with the presumed increase in the number of stressors to which adolescents are exposed as they navigate this critical developmental transition, the way adolescents respond to stressors may vary hormonally, behaviorally and neurally from that of other aged organisms.

#### *Stress and alcohol consumption in adolescents*

The apparent increase in the number of stressors to which adolescents are exposed and their age-typical responses to such stressors have been postulated to contribute to the frequent initiation of alcohol and other drug use in adolescence (e.g., Pohorecky, 1991; Wagner, 1993) as well as to the frequent emergence in adolescence of schizophrenic symptomatology in vulnerable individuals (Walker and Diforio, 1997). Indeed, alcohol use among adolescents has been shown to be predicted by stressors such as prior abuse, victimization and other negative life events (Kilpatrick et al., 2000; Sussman and Dent, 2000); negative school-related events (Unger et al., 2001); neighborhood stress (Scheier et al., 1999); and parental conflict and peer relationship problems (Aseltine and Gore, 2000). Coping strategies may interact with levels of stress in predicting alcohol-related problems (Laurent et al., 1997), with alcohol use suggested to be one of a number of "maladaptive ways to cope with stress" (Scharf, 1999).

Perceiving events as being stressful may be of particular importance in exacerbating the already elevated propensity of human adolescents to exhibit alcohol use and other drug-taking behavior (Baer et al., 1987; Deykin et al., 1987; Tschann et al., 1994; Wills, 1986; but see also Hansell and White, 1991). After peer substance use, the next most powerful predictor of adolescent alcohol and drug use was found by Wagner (1993) to be levels of perceived stress, with the appraisal of events as being stressful of more importance than the absolute number of such events. Adolescents, especially younger adolescents, may be particularly prone to these stressor effects. In her review of the literature on stress effects on alcohol consumption in humans, Pohorecky

(1991) concluded that stress is most convincingly associated with alcohol consumption in adolescence, with more mixed findings evident in studies conducted in adults. Using a linear growth curve analysis to examine age differences in drinking across five waves of data from a community sample of adolescents, Aseltine and Gore (2000) observed the strongest association between stress and drinking among younger adolescents, with the relationship weakening during the late teens and twenties.

Factors contributing to the stress-induced increase in propensity for ethanol use are still being explored. Although the interaction of stress and ethanol intake is complex (for review, see Pohorecky, 1990), stress hormones may play a role. Corticosterone levels in rats generally have been positively related to rates of self-administration of ethanol or other drugs, with adrenalectomy suppressing ethanol consumption (Fahlke et al., 1994) and stress-induced elevations in corticosterone increasing ethanol consumption (e.g., Bowers et al., 1997). Stressors may also enhance the rate of tolerance development to ethanol (Maier and Pohorecky, 1986), thereby indirectly increasing ethanol consumption capacity.

Taken together, the data available to date support the suggestion that the stressors of adolescence along with age-specific neural and hormonal responses to these stressors may contribute to the initiation of ethanol use during adolescence and the emergence of high levels of use among particularly stressed (or stress vulnerable) individuals.

#### **Does Adolescent Alcohol Exposure Alter Ongoing Processes of Brain Development?**

As discussed previously, the adolescent brain is a brain in flux. Many of the brain areas undergoing dramatic developmental change during adolescence are sensitive to ethanol. Ethanol use during adolescence may alter the developmental processes ongoing in these brain regions and hence may have different consequences than similar amounts of ethanol exposure in adulthood. Several recent studies in laboratory animals have supported this possibility. For example, following a 4-day period of multiple ethanol intubations (resulting in exposures of 9-10 g/kg/day), adolescent rats were found to exhibit substantially more ethanol-induced damage in brain regions including the frontal cortex than similarly treated adults (Crews et al., 2000). Rats exposed chronically to ethanol over a 20-day period that included much of the adolescent period were reported subsequently to exhibit a larger impairment in working memory following acute ethanol challenge than adults who were similarly exposed to ethanol (White et al., 2000). These data extend earlier findings in rats showing long-lasting alterations in cognitive functioning following chronic ethanol exposure during adolescence (Osborne and Butler, 1983). Exposure to ethanol vapor for 5 or 10 days has

recently been reported to alter parietal and hippocampal electroencephalogram activity in adolescent rats (Slawewski et al., 2001), whereas the opportunity to consume alcohol voluntarily during adolescence was found to increase later aggressive behavior in male golden hamsters (Ferris et al., 1998; Shtiegman et al., 1997). Whether similar effects would be seen with comparable exposures later in life is unknown in these latter studies, given the absence of adult comparison groups. Nevertheless, it appears from the limited amount of evidence available to date that alcohol exposure during adolescence in laboratory animals may not only disrupt puberty-associated increases in reproductive endocrinology in males (Cicero et al., 1990) and females (Dees et al., 1990), but also may induce long-term alterations in neurobehavioral function as well.

A number of studies have recently examined neurocognitive function in human adolescents with a history of extensive alcohol use. Adolescents with alcohol use disorders had been reported to have smaller hippocampal volumes than comparison subjects, with these hippocampal volumes correlating positively with onset age and negatively with duration of the use disorder (De Bellis et al., 2000). Brown et al. (2000) recently observed subtle to modest neuropsychological impairments, including memory retrieval deficits, in alcohol dependent adolescents with a history of heavy drinking during early and mid-adolescence. It remains to be determined, however, whether these reported associations between alcohol use and neuropsychological impairments are causal and whether these findings are relevant for nonclinical populations of adolescents. Indeed, Bates and Tracy (1990) concluded from their assessments of cognitive functioning in a nonclinical sample of 18- to 24-year olds that "cognitive performance bears little direct relation to drinking behaviors in young nonclinical males and females" (p. 242).

When considering potential long-term consequences of adolescent alcohol use, an important issue is whether this exposure alters later sensitivity to, and patterns of, alcohol use. The data are mixed on this point both in studies conducted in humans and in laboratory animals. For example, findings in rodent studies showing that preweaning (Hayashi and Tadokoro, 1985) or postweaning (Ho et al., 1989) exposure to ethanol increases later ethanol preference are countered by results from several groups reporting no increase in later consumption following periods of ethanol exposure that include adolescence (Kakihana and McClearn, 1963; Parisella and Pritham, 1964; Tolliver and Samson, 1991).

Studies conducted in humans likewise present a mixed picture. Early onset of alcohol use has been reported in both prospective and retrospective studies to be a predictor of later problematic use and dependence on alcohol (Barnes and Welte, 1986; Deykin et al., 1987; Fergusson et al., 1994; Friedman and Humphrey, 1985; Grant and Dawson, 1997; Hawkins et al., 1997; Rachal et al., 1982; Robins

and Przybeck, 1985) and other drugs (Deykin et al. 1987; Robins and McEvoy, 1990; Robins and Przybeck, 1985; Yamaguchi and Kandel, 1984). However, an association between early ethanol use and later problematic use is not always seen. For example, based on findings from four waves of longitudinal data obtained from a nonclinical population ranging in age from 15 to 31 years, Labouvie et al. (1997) concluded that early use of alcohol did not predict drug or alcohol use at either 20 or 30 years of age. Even if early alcohol consumption is found to predict later problematic use and dependence, it is possible that the early use may merely be serving as a marker of later ethanol problems rather than as a causal precursor. For example, in a study of human twins, Prescott and Kendler (1999) reported that the age of initiation of alcohol use was not a direct risk factor for alcoholism, but was an "alternative manifestation of vulnerability to problematic alcohol involvement" (p. 106).

Taken together, recent evidence supports the suggestion that high amounts of alcohol exposure during adolescence may disrupt critical ongoing processes of brain maturation and influence neurocognitive functioning. These findings, however, still need to be replicated and extended, and their relevance to more moderate patterns of alcohol use determined. Whether early exposure to alcohol during adolescence promotes greater ethanol use and probability of dependence later in life remains to be resolved, with mixed findings both in studies with humans as well as in work using animal models of adolescent alcohol exposure.

### Concluding Comments

Alcohol is frequently used by adolescents prior to and during the early college years. This age is critical for study for several reasons. First, the brain of the adolescent is unique and differs from that of younger individuals and adults in numerous regions, including stressor-sensitive, mesocorticolimbic DA projections that are critical for modulating the perceived value of reinforcing stimuli, including use of alcohol and other drugs. These features of adolescent brain may predispose adolescents to behave in particular ways, increasing their sensitivity to stressors and their propensity to initiate alcohol use. Thus, like a number of adolescent behaviors, the predisposition for alcohol use may be in part biologically determined by age-specific neural alterations that continue into late adolescence.

Certainly, given the dramatic differences between the adolescent and the adult brain, it cannot be assumed that factors precipitating the initiation and escalation of alcohol use would be the same during the stressful period of adolescence as in adulthood. Among critical areas for further investigation is the rather paradoxical notion that adolescents may show a reduced sensitivity to many alcohol effects, perhaps supporting elevated intakes to attain

reinforcing effects and a potentially more rapid progression into dependence by adolescents relative to adults. Another important area for future inquiry is the potential long-term consequences of alcohol use during this time of rapid neural and endocrine maturation. It is often the case that rapidly changing systems are particularly vulnerable to disruption, and hence there may be unique long-term consequences of alcohol exposure during adolescence. Data are mixed on this point to date and further research is needed.

### References

- ACHESON, S.K., STEIN, R.M. AND SWARTZWELDER, H.S. Impairment of semantic and figural memory by acute ethanol: Age-dependent effects. *Alcsm Clin. Exp. Res.* **22**: 1437-1442, 1998.
- ANDERSEN, S.L., DUMONT, N.L. AND TEICHER, M.H. Developmental differences in dopamine synthesis inhibition by ( $\pm$ )-7-OH-DPAT. *Naunyn-Schmiedeberg's Arch. Pharmacol.* **356**: 173-181, 1997a.
- ANDERSEN, S.L., RUTSTEIN, M., BENZO, J.M., HOSTETTER, J.C. AND TEICHER, M.H. Sex differences in dopamine receptor overproduction and elimination. *Neuroreport* **8**: 1495-1498, 1997b.
- ARNETT, J. Reckless behavior in adolescence: A developmental perspective. *Devel. Rev.* **12**: 339-373, 1992.
- ASELTINE, R.H., JR. AND GORE, S.L. The variable effects of stress on alcohol use from adolescence to early adulthood. *Subst. Use Misuse* **35**: 643-668, 2000.
- BAER, P.E., GARMEZY, L.B., McLAUGHLIN, R.J., POKORNY, A.D. AND WERNICK, M.J. Stress, coping, family conflict, and adolescent alcohol use. *J. Behav. Med.* **10**: 449-466, 1987.
- BAILEY, C.C. AND KITCHEN, I. Developmental responses to opioids reveals a lack of effect on stress-induced corticosterone levels in neonatal rats. *Brit. J. Pharmacol.* **91**: 119-125, 1987.
- BARNES, G.M. AND WELTE, J.W. Patterns and predictors of alcohol use among 7-12th grade students in New York State. *J. Stud. Alcohol* **47**: 53-62, 1986.
- BATES, M.E. AND LABOUVIE, E.W. Adolescent risk factors and the prediction of persistent alcohol and drug use into adulthood. *Alcsm Clin. Exp. Res.* **21**: 944-950, 1997.
- BATES, M.E. AND TRACY, J.I. Cognitive functioning in young "social drinkers." Is there impairment to detect? *J. Abnorm. Psychol.* **99**: 242-249, 1990.
- BAUMRIND, D. A developmental perspective on adolescent risk taking in contemporary America. In: IRWIN, C.E., JR. (Ed.) *Adolescent Social Behavior and Health*, San Francisco, CA: Jossey-Bass, 1987, pp. 93-125.
- BEATTY, W.W. AND FESSLER, R.G. Gonadectomy and sensitivity to electric shock in the rat. *Physiol. Behav.* **19**: 1-6, 1977.
- BENES, F.M. Myelination of cortical-hippocampal relays during late adolescence. *Schizophren. Bull.* **15**: 585-593, 1989.
- BOWERS, W.J., SABONGUI, A.G. AND AMIT, Z. The role of ethanol availability on stress-induced increases in ethanol consumption. *Alcohol* **14**: 551-556, 1997.
- BRAND, T. AND SLOB, A.K. Peripubertal castration of male rats, adult open field ambulation and partner preference behavior. *Behav. Brain Res.* **30**: 111-117, 1988.
- BROOKS-GUNN, J. AND REITER, E.O. The role of pubertal processes. In: FELDMAN, S.S. AND ELLIOTT, G.R. (Eds.) *At the Threshold: The Developing Adolescent*, Cambridge, MA: Harvard Univ. Press, 1990, pp. 16-53.
- BROWN, S.A. Recovery patterns in adolescent substance abuse. In: BAER, J.S., MARLATT, G.A. AND McMAHON, R.J. (Eds.) *Addictive Behaviors Across the Life Span: Prevention, Treatment, and Policy Issues*, Thousand Oaks, CA: Sage, 1993, pp. 161-183.
- BROWN, S.A., TAPERT, S.F., GRANHOLM, E. AND DELIS, D.C. Neurocognitive functioning of adolescents: Effects of protracted alcohol use. *Alcsm Clin. Exp. Res.* **24**: 164-171, 2000.
- BRUNELL, S.C., RAJENDRAN, P. AND SPEAR, L.P. Ethanol intake and stress adaptation in adolescent and adult rats. *Soc. Neurosci. Abstr.* **27**: 877.12, 2001.
- CHOI, S. AND KELLOGG, C.K. Norepinephrine utilization in the hypothalamus of the male rat during adolescent development. *Devel. Neurosci.* **14**: 369-376, 1992.
- CHOI, S. AND KELLOGG, C.K. Adolescent development influences functional responsiveness of noradrenergic projections to the hypothalamus in male rats. *Devel. Brain Res.* **94**: 144-151, 1996.
- CHOI, S., WEISBERG, S.N. AND KELLOGG, C.K. Control of endogenous norepinephrine release in the hypothalamus of male rats changes over adolescent development. *Devel. Brain Res.* **98**: 134-141, 1997.
- CICERO, T.J., ADAMS, M.L., O'CONNOR, L., NOCK, B., MEYER, E.R. AND WOZNIAK, D. Influence of chronic alcohol administration on representative indices of puberty and sexual maturation in male rats and the development of their progeny. *J. Pharmacol. Exp. Therapeut.* **255**: 707-715, 1990.
- CLARK, D.B., KIRISCI, L. AND TARTER, R.E. Adolescent versus adult onset and the development of substance use disorders in males. *Drug Alcohol Depend.* **49**: 115-121, 1998.
- COULTER, C.L., HAPPE, H.K. AND MURRIN, L.C. Postnatal development of the dopamine transporter: A quantitative autoradiographic study. *Devel. Brain Res.* **92**: 172-181, 1996.
- CREWS, F.T., BRAUN, C.J., HOPLIGHT, B., SWITZER, R.C., 3RD AND KNAPP, D.J. Binge ethanol consumption causes differential brain damage in young adolescent rats compared with adult rats. *Alcsm Clin. Exp. Res.* **24**: 1712-1723, 2000.
- CSIKSZENTMIHALYI, M., LARSON, R. AND PRESCOTT, S. The ecology of adolescent activity and experience. *J. Youth Adolesc.* **6**: 281-294, 1977.
- DE BELLIS, M.D., CLARK, D.B., BEERS, S.R., SOLOFF, P.H., BORING, A.M., HALL, J., KERSH, A. AND KESHAVAN, M.S. Hippocampal volume in adolescent-onset alcohol use disorders. *Amer. J. Psychiat.* **157**: 737-744, 2000.
- DEES, W.L., SKELLEY, C.W., HINEY, J.K. AND JOHNSTON, C.A. Actions of ethanol on hypothalamic and pituitary hormones in prepubertal female rats. *Alcohol* **7**: 21-25, 1990.
- DEYKIN, E.Y., LEVY, J.C. AND WELLS, V. Adolescent depression, alcohol and drug abuse. *Amer. J. Publ. Hlth* **77**: 178-182, 1987.
- DIAMOND, A. Guidelines for the study of brain-behavior relationships during development. In: LEVIN, H.S., EISENBERG, H.M. AND BENTON, A.L. (Eds.) *Frontal Lobe Function and Dysfunction*, New York: Oxford Univ. Press, 1991, pp. 339-378.
- DONOVAN, J.E. Young adult drinking-driving: Behavioral and psychosocial correlates. *J. Stud. Alcohol* **54**: 600-613, 1993.
- DUBAS, J.S. Cognitive abilities and physical maturation. In: LERNER, R.M., PETERSEN, A.C. AND BROOKS-GUNN, J. (Eds.) *Encyclopedia of Adolescence*, Vol. 1, New York: Garland, 1991, pp. 133-138.
- DUMAS, T.C. AND FOSTER, T.C. Late developmental changes in the ability of adenosine A1 receptors to regulate synaptic transmission in the hippocampus. *Devel. Brain Res.* **105**: 137-139, 1998.
- DUNN, A.J. AND KRAMARCY, N.R. Neurochemical responses in stress: Relationships between the hypothalamic-pituitary-adrenal and catecholamine systems. In: IVERSEN, L.L., IVERSEN, S.D. AND SNYDER, S.H. (Eds.) *Handbook of Psychopharmacology*, Vol. 18, New York: Plenum, 1984, pp. 455-515.
- ERNST, A.J., DEMPSTER, J.P., YEE, R., ST. DENNIS, C. AND NAKANO, L. Alcohol toxicity, blood alcohol concentration and body water in young and adult rats. *J. Stud. Alcohol* **37**: 347-356, 1976.

- FAHLKE, C., ENGEL, J.A., ERIKSSON, C.J., HARD, E. AND SODERPALM, B. Involvement of corticosterone in the modulation of ethanol consumption in the rat. *Alcohol* **11**: 195-202, 1994.
- FASSINO, M.J. AND CAMPBELL, B.A. The ontogeny of play in rats. Paper presented at the meeting of the Eastern Psychological Association, New York, 1981.
- FERGUSON, D.M., LYNKEY, M.T. AND HORWOOD, L.J. Childhood exposure to alcohol and adolescent drinking patterns. *Addiction* **89**: 1007-1016, 1994.
- FERRIS, C.F., SHTEIGMAN, K. AND KING, J.A. Voluntary ethanol consumption in male adolescent hamsters increases testosterone and aggression. *Physiol. Behav.* **63**: 739-744, 1998.
- FRIEDMAN, J. AND HUMPHREY, J.A. Antecedents of collegiate drinking. *J. Youth Adolesc.* **14**: 11-21, 1985.
- GABRIEL, S.M., RONCANCIO, J.R. AND RUIZ, N.S. Growth hormone pulsatility and the endocrine milieu during sexual maturation in male and female rats. *Neuroendocrinology* **56**: 619-625, 1992.
- GALLOWAY, M.P., WOLF, M.E. AND ROTH, R.H. Regulation of dopamine synthesis in the medial prefrontal cortex is mediated by release modulating autoreceptors: Studies in vivo. *J. Pharmacol. Exp. Therapeut.* **236**: 689-698, 1986.
- GANJI, V. AND BETTS, N. Fat, cholesterol, fiber and sodium intakes of US population: Evaluation of diets reported in 1987-88 Nationwide Food Consumption Survey. *Europ. J. Clin. Nutr.* **49**: 915-920, 1995.
- GARDNER, E.L. The neurobiology and genetics of addiction: Implications of the "reward deficiency syndrome" for therapeutic strategies in chemical dependency. In: ELSTER, J. (Ed). *Addiction: Entries and Exits*, New York: Russell Sage Foundation, 1999, pp. 57-119.
- GELBARD, H.A., TEICHER, M.H., FAEDDA, G. AND BALDESSARINI, R.J. Postnatal development of dopamine D<sub>1</sub> and D<sub>2</sub> receptor sites in rat striatum. *Devel. Brain Res.* **49**: 123-130, 1989.
- GOEDERS, N.E. A neuroendocrine role in cocaine reinforcement. *Psychoneuroendocrinology* **22**: 237-259, 1997.
- GOLDMAN, L., WINGET, C., HOLLINGSHEAD, G.W. AND LEVINE, S. Postweaning development of negative feedback in the pituitary-adrenal system of the rat. *Neuroendocrinology* **12**: 199-211, 1973.
- GOODRICK, C.L. Alcohol preference of the male Sprague-Dawley albino rat as a function of age. *J. Gerontol.* **22**: 369-371, 1967.
- GOULD, E., WOOLF, N.J. AND BUTCHER, L.L. Postnatal development of cholinergic neurons in the rat: I. Forebrain. *Brain Res. Bull.* **27**: 767-789, 1991.
- GRANT, B.F. AND DAWSON, D.A. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: Results from the National Longitudinal Alcohol Epidemiologic Survey. *J. Subst. Abuse* **9**: 103-110, 1997.
- HANSELL, S. AND WHITE, H.R. Adolescent drug use, psychological distress, and physical symptoms. *J. Hlth Social Behav.* **32**: 288-301, 1991.
- HAWKINS, J.D., GRAHAM, J.W., MAGUIN, E., ABBOTT, R., HILL, K.G. AND CATALANO, R.F. Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. *J. Stud. Alcohol* **58**: 280-290, 1997.
- HAYASHI, T. AND TADOKORO, S. Learning retardation and enhanced ethanol preference produced by postnatal pretreatments with ethanol in adult rats. *Jap. J. Pharmacol.* **37**: 269-276, 1985.
- HO, A., CHIN, A.J. AND DOLE, V.P. Early experience and the consumption of alcohol by adult C57BL/6J mice. *Alcohol* **6**: 511-515, 1989.
- HOLLSTEDT, C., OLSSON, O. AND RYDBERG, U. Effects of ethanol on the developing rat: II. Coordination as measured by the tilting-plane test. *Med. Biol.* **58**: 164-168, 1980.
- HOLLSTEDT, C. AND RYDBERG, U. Postnatal effects of alcohol on the developing rat. In: RYDBERG, U., ALLING, C. AND ENGEL, J. (Eds.) *Alcohol and the Developing Brain*, New York: Raven Press, 1985, pp. 69-84.
- HUTTENLOCHER, P.R. Synapse elimination and plasticity in developing human cerebral cortex. *Amer. J. Mental Defic.* **88**: 488-496, 1984.
- IRWIN, C.E., JR. AND MILLSTEIN, S.G. Correlates and predictors of risk-taking behavior during adolescence. In: LIPSITT, L.P. AND MITNICK, L.L. (Eds.) *Self-Regulatory Behavior and Risk Taking: Causes and Consequences*, Norwood, NJ: Ablex, 1992, pp. 3-21.
- JERNIGAN, T.L., TRAUNER, D.A., HESSELINK, J.R. AND TALLAL, P.A. Maturation of human cerebrum observed in vivo during adolescence. *Brain* **114** (Pt 5): 2037-2049, 1991.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. National Survey Results on Drug Use from the Monitoring the Future Study, 1975-2000, Vol. 1, NIH Publication No. 01-4924, Bethesda, MD: Department of Health and Human Services, 2001.
- KAKIHANA, R. AND MCCLEARN, G.E. Development of alcohol preference in BALB/c mice. *Nature* **199**: 511-512, 1963.
- KALSBECK, A., VOORN, P., BUIJS, R.M., POOL, C.W. AND UYLINGS, H.B. Development of the dopaminergic innervation in the prefrontal cortex of the rat. *J. Comp. Neurol.* **269**: 58-72, 1988.
- KEIR, W.J. AND DEITRICH, R.A. Development of central nervous system sensitivity to ethanol and pentobarbital in short- and long-sleep mice. *J. Pharmacol. Exp. Therapeut.* **254**: 831-835, 1990.
- KENNEDY, G.C. AND MITRA, J. Body weight and food intake as initiating factors for puberty in the rat. *J. Physiol.* **166**: 408-418, 1963.
- KIESS, W., MEIDERT, A., DRESSENDÖRFER, R.A., SCHRIEVER, K., KESSLER, U., KÖNIG, A., SCHWARZ, H.P. AND STRASBURGER, C.J. Salivary cortisol levels throughout childhood and adolescence: Relation with age, pubertal stage, and weight. *Pediat. Res.* **37** (4 Pt 1): 502-506, 1995.
- KILPATRICK, D.G., ACIERNO, R., SAUNDERS, B., RESNICK, H.S., BEST, C.L. AND SCHNURR, P.P. Risk factors for adolescent substance abuse and dependence: Data from a national sample. *J. Cons. Clin. Psychol.* **68**: 19-30, 2000.
- KOOB, G.F. Neural mechanisms of drug reinforcement. *Ann. N.Y. Acad. Sci.* **654**: 171-191, 1992.
- KOSTOVIC, I. Structural and histochemical reorganization of the human prefrontal cortex during perinatal and postnatal life. In: UYLINGS, H.B.M., VAN EDEN, C.G., DE BRUIN, J.P.C., CORNER, M.A. AND FEENSTRA, M.G.P. (Eds.) *Progress in Brain Research*, Vol. 85: The Prefrontal Cortex: Its Structure, Function and Pathology, New York: Elsevier Science, 1990, pp. 223-240.
- KURTZ, M.M. AND CAMPBELL, B.A. Paradoxical autonomic responses to aversive stimuli in the developing rat. *Behav. Neurosci.* **108**: 962-971, 1994.
- LABOUVIE, E., BATES, M.E. AND PANDINA, R.J. Age of first use: Its reliability and predictive utility. *J. Stud. Alcohol* **58**: 638-643, 1997.
- LANCASTER, F.E., BROWN, T.D., COKER, K.L., ELLIOTT, J.A. AND WREN, S.B. Sex differences in alcohol preference and drinking patterns emerge during the early postpubertal period in Sprague-Dawley rats. *Alcsm Clin. Exp. Res.* **20**: 1043-1049, 1996.
- LARSON, R. AND ASMUSSEN, L. Anger, worry, and hurt in early adolescence: An enlarging world of negative emotions. In: COLTEN, M.E. AND GORE, S. (Eds.) *Adolescent Stress: Causes and Consequences*, Hawthorne, NY: Aldine de Gruyter, 1991, pp. 21-41.
- LARSON, R. AND RICHARDS, M.H. (Eds.) *Divergent Realities: The Emotional Lives of Mothers, Fathers, and Adolescents*, New York: Basic Books, 1994.
- LAURENT, J., CATANZARO, S.J. AND CALLAN, M.K. Stress, alcohol-related expectancies and coping preferences: A replication with adolescents of the Cooper et al. (1992) model. *J. Stud. Alcohol* **58**: 644-651, 1997.
- LEWIS, D.A. Development of the prefrontal cortex during adolescence: Insights into vulnerable neural circuits in schizophrenia. *Neuropsychopharmacology* **16**: 385-398, 1997.
- LITTLE, P.J., KUHN, C.M., WILSON, W.A. AND SWARTZWELDER, H.S. Differential effects of ethanol in adolescent and adult rats. *Alcsm Clin. Exp. Res.* **20**: 1346-1351, 1996.
- MAIER, D.M. AND POHORECKY, L.A. The effect of stress on tolerance to ethanol in rats. *Alcohol Drug Res.* **6**: 387-401, 1986.



- MARKWIESE, B.J., ACHESON, S.K., LEVIN, E.D., WILSON, W.A. AND SWARTZWELDER, H.S. Differential effects of ethanol on memory in adolescent and adult rats. *Alcsm Clin. Exp. Res.* **22**: 416-421, 1998.
- MEANEY, M.J., SAPOLSKY, R.M. AND McEWEN, B.S. The development of the glucocorticoid receptor system in the rat limbic brain: I. Ontogeny and autoregulation. *Brain Res.* **350** (1-2): 159-164, 1985a.
- MEANEY, M.J., SAPOLSKY, R.M. AND McEWEN, B.S. The development of the glucocorticoid receptor system in the rat limbic brain: II. An autoradiographic study. *Brain Res.* **350** (1-2): 165-168, 1985b.
- MOY, S.S., DUNCAN, G.E., KNAPP, D.J. AND BREESE, G.R. Sensitivity to ethanol across development in rats: Comparison to [<sup>3</sup>H] zolpidem binding. *Alcsm Clin. Exp. Res.* **22**: 1485-1492, 1998.
- NANCE, D.M. The developmental and neural determinants of the effects of estrogen on feeding behavior in the rat: A theoretical perspective. *Neurosci. Biobehav. Rev.* **7**: 189-211, 1983.
- ODELL, W.D. Sexual maturation in the rat. In: GRUMBACH, M.M., SIZONENKO, P.C. AND AUBERT, M.L. (Eds.) *Control of the Onset of Puberty*, Philadelphia, PA: Lippincott Williams & Wilkins, 1990, pp. 183-210.
- OJEDA, S.R. AND URBANSKI, H.F. Puberty in the Rat. In: KNOBIL, E. AND NEILL, J.D. (Eds.) *The Physiology of Reproduction*, 2nd Edition, New York: Raven Press, 1994, pp. 363-409.
- OSBORNE, G.L. AND BUTLER, A.C. Enduring effects of periadolescent alcohol exposure on passive avoidance performance in rats. *Physiol. Psychol.* **11**: 205-208, 1983.
- PARISELLA, R.M. AND PRITHAM, G.H. Effect of age on alcohol preference by rats. *Q. J. Stud. Alcohol* **25**: 248-252, 1964.
- PETERSEN, A.C., SILBEREISEN, R.K. AND SOERENSON, S. Adolescent development: A global perspective. In: HURRELMANN, K. AND HAMILTON, S.F. (Eds.) *Social Problems and Social Contexts in Adolescence: Perspectives Across Boundaries*, Hawthorne, NY: Aldine de Gruyter, 1996, pp. 3-37.
- PIAZZA, P.V., ROUGÉ-PONT, F., DEMINIÈRE, J.M., KHAROUBI, M., LEMOAL, M. AND SIMON, H. Dopaminergic activity is reduced in the prefrontal cortex and increased in the nucleus accumbens of rats predisposed to develop amphetamine self-administration. *Brain Res.* **567**: 169-174, 1991.
- POHORECKY, L.A. Interaction of ethanol and stress: Research with experimental animals—an update. *Alcohol Alcsm* **25** (2-3): 263-276, 1990.
- POHORECKY, L.A. Stress and alcohol interaction: An update of human research. *Alcsm Clin. Exp. Res.* **15**: 438-459, 1991.
- POLLOCK, N.K. AND MARTIN, C.S. Diagnostic orphans: Adolescents with alcohol symptoms who do not qualify for DSM-IV abuse or dependence diagnoses. *Amer. J. Psychiat.* **156**: 897-901, 1999.
- POST, G.B. AND KEMPER, H.C. Nutrient intake and biological maturation during adolescence. *The Amsterdam Growth and Health Longitudinal Study.* *Europ. J. Clin. Nutr.* **47**: 400-408, 1993.
- PRESCOTT, C.A. AND KENDLER, K.S. Age at first drink and risk for alcoholism: A noncausal association. *Alcsm Clin. Exp. Res.* **23**: 101-107, 1999.
- PRIMUS, R.J. AND KELLOGG, C.K. Pubertal-related changes influence the development of environment-related social interaction in the male rat. *Devel. Psychobiol.* **22**: 633-643, 1989.
- RACHAL, J.V., GUESS, L.L., HUBBARD, R.L. AND MAISTO, S.A. Alcohol misuse by adolescents. *Alcohol Hlth Res. World* **6**: 61-68, 1982.
- RAMALEY, J.A. AND OLSON, J. Adrenal function in rats given PMS before puberty: Response to ether stress. *Neuroendocrinology* **14**: 1-13, 1974.
- RIVIER, C. Effect of the age of the rat and the duration of the stimulus on stress-induced ACTH secretion. In: WEINER, H., FLORIN, I., MURISON, R. AND HELLHAMMER, D. (Eds.) *Frontiers of Stress Research*, Toronto, Canada: Hans Huber, 1989, pp. 223-232.
- ROBINS, L.N. AND McEVoy, L. Conduct problems as predictors of substance abuse. In: ROBINS, L.N. AND RUTTER, M. (Eds.) *Straight and Devious Pathways from Childhood to Adulthood*, New York: Cambridge Univ. Press, 1990, pp. 182-204.
- ROBINS, L.N. AND PRZYBECK, T.R. Age of onset of drug use as a factor in drug and other disorders. In: JONES, C.L. AND BATTJES, R.J. (Eds.) *Etiology of Drug Abuse: Implications for Prevention*. NIDA Research Monograph No. 56, DHHS Publication No. (ADM) 85-1335, Washington: Government Printing Office, 1985, pp. 178-192.
- ROSENBERG, D.R. AND LEWIS, D.A. Changes in the dopaminergic innervation of monkey prefrontal cortex during late postnatal development: A tyrosine hydroxylase immunohistochemical study. *Biol. Psychiat.* **36**: 272-277, 1994.
- SAPOLSKY, R.M., MEANEY, M.J. AND McEWEN, B.S. The development of the glucocorticoid receptor system in the rat limbic brain: III. Negative-feedback regulation. *Brain Res.* **350** (1-2): 169-173, 1985.
- SCHARF, A.A. Environmental stress, potential protective factors, and adolescent risk-taking. *Dissert. Abstr. Int.* **59** (8-B): 4513, 1999.
- SCHIEER, L.M., BOTVIN, G.J. AND MILLER, N.L. Life events, neighborhood stress, psychosocial functioning, and alcohol use among urban minority youth. *J. Child Adolesc. Subst. Abuse* **9**: 19-50, 1999.
- SCHLEGEL, A. AND BARRY, H., 3RD (Eds.) *Adolescence: An Anthropological Inquiry*, New York: Free Press, 1991.
- SEEMAN, P., BZOWEJ, N.H., GUAN, H.-C., BERGERON, C., BECKER, L.E., REYNOLDS, G.P., BIRD, E.D., RIEDERER, P., JELLINGER, K., WATANABE, S. AND TOURTELLOTTE, W.W. Human brain dopamine receptors in children and aging adults. *Synapse* **1**: 399-404, 1987.
- SHTIEGMAN, K., KING, J.A. AND FERRIS, C.F. Voluntary ethanol consumption during adolescence in golden hamsters elevates blood testosterone and increases aggression in early adulthood. Poster presented at the meeting of the Society for Neuroscience, New Orleans, LA, 1997.
- SILVERI, M.M. AND SPEAR, L.P. Decreased sensitivity to the hypnotic effects of ethanol early in ontogeny. *Alcsm Clin. Exp. Res.* **22**: 670-676, 1998.
- SILVERI, M.M. AND SPEAR, L.P. Ontogeny of rapid tolerance to the hypnotic effects of ethanol. *Alcsm Clin. Exp. Res.* **23**: 1180-1184, 1999.
- SILVERI, M.M. AND SPEAR, L.P. Ontogeny of ethanol elimination and ethanol-induced hypothermia. *Alcohol* **20**: 45-53, 2000.
- SILVERI, M.M. AND SPEAR, L.P. Acute, rapid, and chronic tolerance during ontogeny: Observations when equating ethanol perturbation across age. *Alcsm Clin. Exp. Res.* **25**: 1301-1308, 2001.
- SILVERI, M.M. AND SPEAR, L.P. The effects of NMDA and GABA<sub>A</sub> pharmacological manipulations of ethanol sensitivity in immature and mature animals. *Alcsm Clin. Exp. Res.*, in press.
- SLAWECKI, C.J., BETANCOURT, M., COLE, M. AND EHLERS, C.L. Periadolescent alcohol exposure has lasting effects on adult neurophysiological function in rats. *Devel. Brain Res.* **128**: 63-72, 2001.
- SPEAR, L.P. The adolescent brain and age-related behavioral manifestations. *Neurosci. Biobehav. Rev.* **24**: 417-463, 2000.
- SPEAR, L.P. AND BRAKE, S.C. Periadolescence: Age-dependent behavior and psychopharmacological responsivity in rats. *Devel. Psychobiol.* **16**: 83-109, 1983.
- SPEAR, L.P., SHALABY, I.A. AND BRICK, J. Chronic administration of haloperidol during development: Behavioral and psychopharmacological effects. *Psychopharmacology* **70**: 47-58, 1980.
- SPIERS, D.E. AND FUSCO, L.E. Age-dependent differences in the thermoregulatory response of the immature rat to ethanol. *Alcsm Clin. Exp. Res.* **15**: 23-28, 1991.
- STANWOOD, G.D., McELLIOT, S., LU, L. AND McGONIGLE, P. Ontogeny of dopamine D3 receptors in the nucleus accumbens of the rat. *Neurosci. Lett.* **223**: 13-16, 1997.
- STONE, E.A. AND QUARTERMAIN, D. Greater behavioral effects of stress in immature as compared to mature male mice. *Physiol. Behav.* **63**: 143-145, 1997.
- SUSMAN, E.J., INOFF-GERMAIN, G., NOTTELMANN, E.D., LORIAUX, D.L., CUTLER, G.B., JR. AND CHROUSOS, G.P. Hormones, emotional disposition, and aggressive attributes in young adolescents. *Child Devel.* **58**: 1114-1134, 1987.

- SUSSMAN, S. AND DENT, C.W. One-year prospective prediction of drug use from stress-related variables. *Subst. Use Misuse* **35**: 717-735, 2000.
- SWARTZWELDER, H.S., RICHARDSON, R.C., MARKWIESE-FOERCH, B., WILSON, W.A. AND LITTLE, P.J. Developmental differences in the acquisition of tolerance to ethanol. *Alcohol* **15**: 311-314, 1998.
- SWARTZWELDER, H.S., WILSON, W.A. AND TAYYEB, M.I. Differential sensitivity of NMDA receptor-mediated synaptic potentials to ethanol in immature versus mature hippocampus. *Alcsm Clin. Exp. Res.* **19**: 320-323, 1995a.
- SWARTZWELDER, H.S., WILSON, W.A. AND TAYYEB, M.I. Age-dependent inhibition of long-term potentiation by ethanol in immature versus mature hippocampus. *Alcsm Clin. Exp. Res.* **19**: 1480-1485, 1995b.
- TEICHER, M.H., ANDERSEN, S.L. AND HOSTETTER, J.C., JR. Evidence for dopamine receptor pruning between adolescence and adulthood in striatum but not nucleus accumbens. *Devel. Brain Res.* **89**: 167-172, 1995.
- TEICHER, M.H., BARBER, N.I., GELBARD, H.A., GALLITANO, A.L., CAMPBELL, A., MARSH, E. AND BALDESSARINI, R.J. Developmental differences in acute nigrostriatal and mesocorticolimbic system response to haloperidol. *Neuropsychopharmacology* **9**: 147-156, 1993.
- TEICHER, M.H., GALLITANO, A.L., GELBARD, H.A., EVANS, H.K., MARSH, E.R., BOOTH, R.G. AND BALDESSARINI, R.J. Dopamine D<sub>1</sub> autoreceptor function: Possible expression in developing rat prefrontal cortex and striatum. *Devel. Brain Res.* **63** (1-2): 229-235, 1991.
- TOLLIVER, G.A. AND SAMSON, H.H. The influence of early postweaning ethanol exposure on oral self-administration behavior in the rat. *Pharmacol. Biochem. Behav.* **38**: 575-580, 1991.
- TSCHANN, J.M., ADLER, N.E., IRWIN, C.E., JR., MILLSTEIN, S.G., TURNER, R.A. AND KEGELES, S.M. Initiation of substance use in early adolescence: The roles of pubertal timing and emotional distress. *Hlth Psychol.* **13**: 326-333, 1994.
- UNGER, J.B., LI, Y., JOHNSON, C.A., GONG, J., CHEN, X., LI, C.Y., TRINIDAD, D.R., TRAN, N.T. AND LO, A.T. Stress life events among adolescents in Wuhan, China: Associations with smoking, alcohol use, and depressive symptoms. *Int. J. Behav. Med.* **8**: 1-18, 2001.
- VAN EDEN, C.G., KROS, J.M. AND UYLINGS, H.B.M. The development of the rat prefrontal cortex: Its size and development of connections with thalamus, spinal cord and other cortical areas. In: UYLINGS, H.B.M., VAN EDEN, C.G., DE BRUIN, J.P.C., CORNER, M.A. AND FEENSTRA, M.G.P. (Eds.) *Progress in Brain Research: Vol. 85. The Prefrontal Cortex: Its Structure, Function and Pathology*, New York: Elsevier Science, 1990, pp. 169-183.
- VARLINSKAYA, E.I. AND SPEAR, L.P. Anxiolytic effects of ethanol in adolescent and adult rats. Poster presented at the meeting of the Research Society on Alcoholism, Montreal, Canada, 2001.
- WAGNER, E.F. Delay of gratification, coping with stress, and substance use in adolescence. *Exp. Clin. Psychopharmacol.* **1** (1-4): 27-43, 1993.
- WALKER, C.-D., PERRIN, M., VALE, W. AND RIVIER, C. Ontogeny of the stress response in the rat: Role of the pituitary and the hypothalamus. *Endocrinology* **118**: 1445-1451, 1986.
- WALKER, C.-D., TROTTIER, G., ROCHFORD, J. AND LAVALLÉE, D. Dissociation between behavioral and hormonal responses to the forced swim stress in lactating rats. *J. Neuroendocrinol.* **7**: 615-622, 1995.
- WALKER, E.F. AND DIFORIO, D. Schizophrenia: A neural diathesis-stress model. *Psychol. Rev.* **104**: 667-685, 1997.
- WHALEN, C.K., JAMNER, L.D., HENKER, B. AND DELFINO, R.J. Smoking and moods in adolescents with depressive and aggressive dispositions: Evidence from surveys and electronic diaries. *Hlth Psychol.* **20**: 99-111, 2001.
- WHITE, A.M., GHIA, A.J., LEVIN, E.D. AND SWARTZWELDER, H.S. Binge pattern ethanol exposure in adolescent and adult rats: Differential impact on subsequent responsiveness to ethanol. *Alcsm Clin. Exp. Res.* **24**: 1251-1256, 2000.
- WILLS, T.A. Stress and coping in early adolescence: Relationships to substance use in urban school samples. *Hlth Psychol.* **5**: 503-529, 1986.
- WOLFER, D.P. AND LIPP, H.-P. Evidence for physiological growth of hippocampal mossy fiber collaterals in the guinea pig during puberty and adulthood. *Hippocampus* **5**: 329-340, 1995.
- YAMAGUCHI, K. AND KANDEL, D.B. Patterns of drug use from adolescence to young adulthood: III. Predictors of progression. *Amer. J. Publ. Hlth* **74**: 673-681, 1984.
- YORK, J.L. AND CHAN, A.W. Age-related differences in sensitivity to alcohol in the rat. *Alcsm Clin. Exp. Res.* **17**: 864-869, 1993.
- ZECEVIC, N., BOURGEOIS, J.-P. AND RAKIC, P. Changes in synaptic density in motor cortex of rhesus monkey during fetal and postnatal life. *Devel. Brain Res.* **50**: 11-32, 1989.
- ZORZANO, A. AND HERRERA, E. Decreased in vivo rate of ethanol metabolism in the suckling rat. *Alcsm Clin. Exp. Res.* **13**: 527-532, 1989.

# College Factors That Influence Drinking

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**ABSTRACT.** *Objective:* The purpose of this article is to examine the aspects of collegiate environments, rather than student characteristics, that influence drinking. Unfortunately, the existing literature is scant on this topic. *Method:* A literature review of articles primarily published within the last 10 years, along with some earlier “landmark” studies of collegiate drinking in the United States, was conducted to determine institutional factors that influence the consumption of alcohol. In addition, a demonstration analysis of Core Alcohol and Drug Survey research findings was conducted to further elucidate the issues. *Results:* Several factors have been shown to relate to drinking: (1) organizational property variables of campuses, including affiliations (historically black institutions, women’s institutions), presence of a Greek system, athletics

and 2- or 4-year designation; (2) physical and behavioral property variables of campuses, including type of residence, institution size, location and quantity of heavy episodic drinking; and (3) campus community property variables, including pricing and availability and outlet density. Studies, however, tend to look at individual variables one at a time rather than in combination (multivariate analyses). Some new analyses, using Core Alcohol and Drug Survey data sets, are presented as examples of promising approaches to future research. *Conclusions:* Given the complexities of campus environments, it continues to be a challenge to the field to firmly establish the most compelling institutional and environmental factors relating to high-risk collegiate drinking. (*J. Stud. Alcohol*, Supplement No. 14: 82-90, 2002)

IT HAS BEEN almost 50 years since Straus and Bacon (1953) first reported that alcohol on college campuses presented problems to college and university administrators. More recently, in 1989, a survey found that more than 67% of college presidents rated alcohol misuse to be a “moderate” or “major” problem on their campuses (Carnegie Foundation for the Advancement of Teaching, 1990). More to the point, college presidents described alcohol misuse as the single greatest threat to the quality of campus life. This concern has not diminished since the passage of the Drug Free Schools and Communities Act of 1986 and its Amendments of 1989, as evidenced by media reports that have inundated the public of sexual assaults, campus violence, personal injury and deaths where alcohol was cited as a factor in the incidents.

Researchers report that approximately 44% of full-time students at 4-year institutions engage in “binge” or heavy episodic drinking patterns (Wechsler et al., 1994) as do 45.6% of full- and part-time students at 2- and 4-year institutions (Presley et al., 1998). In addition, the Monitoring the Future Study (Johnston et al., 1998a) reported that there have been some notable increases in illicit drug use among American junior and senior high school students since 1992. Many of these students will attend college within a few years and will bring these difficulties with them.

For years, one response that college and university officials offered regarding drinking on campus was that alcohol use and even misuse was a developmental rite of passage for students and that, if left alone, these students would pass through these stages of involvement with alcohol without great injury or harm (Jessor and Jessor, 1975). More recently, institutions of higher education have focused on education and intervention strategies oriented to individual students (Wallack and DeJong, 1995). This response has reflected the view that those who experience problems do so because of some genetic or characterological deficit, and if ignorance were removed about the effects and dangers of alcohol use or the enforcement of laws and policies, problematic alcohol use would diminish. But, as former deputy drug czar Herbert Kleber stated so clearly, “Education is the cure to the extent that ignorance is the disease” (personal communication, 1989). Here we are more than 10 years later, and we have not “cured” the problem, despite numerous educational programs.

“There is still a great deal to be learned about university campus culture as it interacts with demographic and personality variables to influence the use and abuse of alcohol,” Brennan et al. (1986, p. 490) asserted. In their research, Shore et al. (1983) also surmised that campus factors can affect drinking habits of college students. They found that resistance to peer pressure to drink and the desire to refrain from drinking were more intensely related to college environmental variables than to personal background variables. Moos (1976) found that although many individuals can resist environmental influences, some collegiate environments are powerful enough to influence almost everyone. Shore

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et al. (1983) suggested that the recognition that campus life is isolated or in some way insulated from the “real world” has been one of the most important factors in focusing on immediate environmental variables over earlier developmental influences such as religious orientation or parents’ drinking habits. This focus is consistent with the Core Survey finding that almost one-fifth of students in college report taking their first drink after reaching age 18 (Presley et al., 1996a).

The relationship between environment and behavior is complex; adding to this complexity, collegiate environments can no longer be typified as a single culture nor can students be described as homogeneously as in years past (Upcraft, 1999). More nontraditional students are attending college, and the percentage of ethnic minority students is steadily increasing (National Center for Education Statistics, 1994). In addition, there is a growing recognition that what constitutes a campus environment can be difficult to describe. The boundaries of this environment have become less clear because of the increasing recognition that students receive their communications and messages from a vast number of sources and multiple competing interests. Distance learning, nearby but “off-campus” housing, the local business environment adjacent to campus and the Internet all blur the outlines of where the campus environment begins and ends. DeJong et al. (1998) asserted that there were at least five institutional and community factors that constitute the environment of college for today’s student. Astin (1993) and Pascarella and Terenzini (1991) identified more than 200 “environmental” or factor variables that have varying degrees of influence on individual college students. Many of these factors have been studied independently as well as in relationship to each other.

Although no one conceptual model exists that links college environmental factors with individual student characteristics, the scope of this article is to identify and present relevant moderating environmental variables that have been shown to impact on individual student behavior with regard to alcohol use and misuse. For organizational purposes, this article presents three categories under which many of the environmental variables of concern can be subsumed: physical property variables, organizational property variables and campus/community variables.

In this article, we (1) review and synthesize what is currently known about collegiate environmental factors that impact on the quality of academic life and that influence alcohol use and misuse and (2) identify methodological and research limitations of existing literature and make recommendations for future directions. We do so with the following assumptions:

- Individuals are not passive members of the university or college community. The university campus culture interacts with

personality and experiential variables to influence the use and misuse of alcohol.

- The conditions that influence alcohol in the campus environment can be thought of as deriving from a number of properties of campuses, and each of these categories of variables has an impact on student behaviors.
- The categories are not mutually exclusive. Prevention efforts directed to decrease risk for alcohol misuse and illicit substance use and to enhance protective factors must be based on an understanding of how the categories of variables interact with each other.

## Method

Reviewed in this chapter are articles primarily published within the last 10 years, although some earlier “landmark” studies are also cited. The studies are limited to colleges and universities in the United States but include both 2- and 4-year institutions. Although the focus is on high quality multi-institutional studies using random and representative samples, single college studies are included if they add significantly to an understanding of the research question at hand or point to new research directions. Studies include those that are more descriptive in nature as well as some that have employed more sophisticated analyses. Some new types of analyses, using Core Alcohol and Drug Survey data sets, are presented as examples of promising approaches to future research.

## Results

Variables germane to this discussion are organized into the following categories: (1) organizational property variables of campuses, including affiliations (historically black institutions, women’s institutions), presence of a Greek system, athletics and 2- or 4-year designation; (2) physical and behavioral property variables of campuses, including type of residence, institution size, location and quantity of high-risk/heavy episodic drinking; and (3) campus community property variables, including pricing and availability and outlet density.

### *Organizational property variables of campuses*

*Historically black colleges and other racial/ethnic findings.* After reviewing various outcomes of those who attend predominantly black or single-gender institutions, Pascarella and Terenzini (1991) found that attendance at a predominantly black institution is not associated with any educational disadvantage. To the contrary, they found that some of the benefits included “larger increases in certain areas of cognitive development, brighter prospects for completing a baccalaureate degree program, and indirectly, the higher post-college earning associated with degree completion” (p. 638).

In two multicollege studies, Meilman et al. (1994, 1995) found that black students were much less likely to indulge in alcohol and high-risk/heavy episodic drinking practices than were white students. In addition, they experienced far fewer damaging consequences of heavy drinking. Although the first published article investigated the differences in drinking habits of more than 40,000 college students, it did not answer the question regarding the drinking habits of black students at historically black institutions and black students at predominantly white institutions. An additional related question for the second article was whether the drinking habits of white students at historically black institutions differed from that of white students at predominantly white institutions. The methodology for the second study entailed a matched sample that included 12,351 students—6,222 at 14 historically black institutions and 6,129 at 14 predominantly white institutions. The second analysis, which corroborated the earlier research findings of distinct ethnic differences in the use of alcohol among college students, found that those differences asserted themselves regardless of institutional setting and that drinking and high-risk/heavy episodic drinking levels at historically black institutions were significantly lower than at predominantly white institutions.

Additional studies using Core Survey findings have shown that Native American/Alaska Native students and white students use the most alcohol, black and Asian students use the least and Latino/Latina students are in a middle range (Presley et al., 1993a, 1995, 1996a,b).

Thus, research supports the view that there are institutional factors based on race that may enhance or reduce excessive alcohol use. Predominantly white institutions will show more problematic alcohol use, and historically black institutions will show less.

*Women's colleges.* Similarly, Pascarella and Terenzini (1991) reported that attendance at single-gender institutions provided educational benefits "less likely on coeducational campuses. These findings held constant even with student background characteristics and institutional selectivity held constant" (p. 638). Consistent with this report, it is not surprising that additional research has found the following with regard to alcohol use on these types of campuses.

Although many studies indicated that women generally consume less alcohol, engage in high-risk/heavy episodic drinking episodes less frequently and experience fewer negative consequences than men in institutions of higher education (Engs and Hanson, 1985; Presley et al., 1993a, 1995, 1996a,b; Wechsler et al. 1994), the first study to examine the prevalence of women's drinking and the correlates of women's drinking at women's colleges was Wechsler et al. (1995). This study of 508 women found that women at women's colleges engaged in high-risk drinking (defined as four or more drinks in a row in the previous 2 weeks) less frequently and had fewer alcohol-related problems than women at coeducational institutions.

In a data analysis of six women's colleges conducted for this article with a sample size of 1,311 students, the Core Institute found that heavy episodic drinking (defined as five or more drinks in a row in the previous 2 weeks) on these campuses ranged from a low of 23% of the women to a high of 42%, with a mean of 32%. The percentage of women who were classified as frequent drinkers (three or more times per week) ranged from 5.6% to 20.9%.

By way of comparison, overall data for women in 1992-1994 (Presley et al., 1996a) indicated that 14.0% of the women at the 89 colleges surveyed were frequent drinkers (three or more times per week), with 30.7% of the women reporting episodes of heavy episodic drinking within the previous 2 weeks. Therefore, the aggregated numbers for women do not look very different from those of the six women's colleges. However, Core Survey data on women from 1997 from a further analysis of data from Presley et al. (1998) show a frequent drinking rate of 17.4% and a heavy episodic drinking rate of 38.3%, numbers that are substantially higher than for the sample at women's colleges.

Given the inconsistency in national findings, it is not clear whether there is a meaningful distinction in the drinking rates of women attending women's colleges as compared with those attending coeducational colleges. More research is necessary to determine conclusively whether attendance at women's colleges mitigates against excessive alcohol use.

*Presence of a Greek system.* A number of single institution studies have found that members of Greek organizations are more likely to drink compared with other students (Klein, 1989; Lo and Globetti, 1993; Werner and Greene, 1992). Each of these studies reported that Greek affiliation—living in a Greek house, belonging to a Greek organization, intent to join the Greek system—is correlated with higher rates of heavy episodic drinking, frequency of drinking and negative consequences. The findings of these studies have been corroborated by data from the College Alcohol Study (Wechsler, 1995) and the Core Institute (Cashin et al., 1998; Presley et al., 1993b). Wechsler found that 60% of the fraternity members had been heavy episodic drinkers in high school and more than 75% of fraternity residents who had not engaged in heavy episodic drinking episodes in high school became heavy episodic drinkers in college. Greek living did make a greater significant contribution than other variables that were studied.

Cashin et al. (1998) found that fraternity and sorority leaders used more alcohol than nonmembers and members alike and speculated that these leaders are participating in setting drinking norms for their groups. An earlier data analysis (Presley et al., 1993b) found that Greek house residents had extraordinarily high levels of problematic alcohol use and negative consequences compared with students in general.

It should be noted that although the presence of a Greek system contributes to the percentage of heavy episodic drinkers on campus, there are also a number of institutions that have no Greek system and yet also have a high percentage of heavy episodic drinkers.

*Athletics.* Again multi-institutional research (Leichliter et al., 1998; Wechsler et al., 1997) has found that student involvement in athletics, whether partially involved or as a leader, is positively associated with heavy episodic drinking. Athletes were more likely to experience negative consequences of alcohol misuse and illicit substance use than nonathletes.

In addition, it has been demonstrated that athletes who are members of a sorority or fraternity are at even greater risk (Meilman et al., 1999). However, no study to date has looked at the issue in terms of percentages of campuses that have Greek organizations and athletic groups and how these relate to overall campus alcohol consumption and campus culture. Theoretically speaking, institutions that have high percentages of athletes and members of Greek organizations should demonstrate heavier alcohol consumption and related difficulties.

*Two- or four-year designation.* Data from four 2-year cohorts of colleges and universities show that students at 2-year institutions reported lower average weekly consumption levels and a lower percentage of heavy episodic drinking than students at 4-year schools (Presley et al., 1993a, 1995, 1996a,b).

#### *Physical and behavioral property variables of campuses*

*Type of residence.* Fromme and Ruela (1994) found that although parents and peers were both influential in defining standards of drinking, peers were more influential in terms of affecting actual drinking behavior. The authors suggested that normative influences vary for college students depending on *where* they reside while attending school.

We speculate that, in fact, students may seek out certain environments based on their expectancies of alcohol use. In a survey of 606 Rutgers University undergraduates, O'Hare (1990) found that there were differences in drinking rates depending on the living arrangements. Commuters living at home were more likely to be lighter drinkers than students who lived on campus. O'Hare found that men were twice as likely to be heavy drinkers if they lived on campus. However, women living independently had higher rates of heavy drinking than women living on campus or at their parents' homes. These findings appear to dovetail nicely with Harford et al.'s (1983) study, which found that the number of roommates was significantly related to drinking contexts. Students living at home were more likely to drink in nightclubs and bars, and residence hall students were more likely to drink in large, mixed-gender groups in their residences.

Differences in drinking levels were found for Core Survey respondents based on whether they lived in on- or off-campus housing (Presley et al., 1996a). The average number of drinks per week and the number of heavy episodic drinking episodes were all higher for on-campus residents as compared with off-campus residents, and students with the highest levels of consumption and heavy episodic drinking episodes were those who lived in a fraternity or sorority house (Presley et al., 1993b).

*Size and region.* Research from the Core Institute has shown that size of institution is generally associated with quantity of alcohol consumed, with students at smaller schools consuming greater amounts of alcohol on an average weekly basis than students at larger schools (Presley et al., 1993a, 1995, 1996a,b). It has also been consistently shown that students at schools in the Northeast section of the United States consume more alcohol and have higher episodic drinking rates than students in other sections of the country, with the North Central region not far behind (Presley et al., 1993a, 1995, 1996a,b). These sections of the country also show the highest figures for occasional heavy use and annual and 30-day prevalence rates among young adults generally (Johnston et al., 1998b).

*Behavioral variable: Quantity of heavy episodic drinking.* Data from the College Alcohol Study (Wechsler et al., 1999) of full-time students at 114 four-year institutions indicated that the median number of drinks consumed by all students regardless of drinking status was 1.5, yet the median number of drinks per week for frequent heavy episodic drinkers was 14.5 drinks per week. One in five students, it was found, was a frequent heavy episodic drinker. This study showed that behavioral norms for alcohol consumption varied widely among students and across colleges. This suggests the utility of looking at the characteristics of institutions where heavy episodic drinking takes place. Campuses where heavy episodic drinking takes place are different environments because of the behavior of the students, and therefore it is useful to learn more about them.

To date, there has been little published on the characteristics of institutions that have high heavy episodic drinking rates versus the characteristics of schools with low and moderate heavy episodic drinking rates. For purposes of this article and to further a discussion about this college context variable, the following analyses were conducted for this article using information from the Core Institute.

In this secondary data analysis we used data from 201 institutions across the nation that administered the Core Alcohol and Drug Survey between 1995 and 1998. The institutions were representative geographically and voluntarily chose to survey their campuses; the students within each institution were sampled in a random and representative fashion. This particular aggregation of data contains 93,536 students. This analysis is presented for demonstration and informational purposes based on suggestions from Patrick

TABLE 1. Regional location of low, medium and high heavy episodic drinking (HED) schools, in percent

Region	Low HED schools	Medium HED schools	High HED schools
West	23.1	19.7	10.8
North Central	13.8	39.4	16.9
South	44.6	13.6	18.5
Northeast	18.5	27.3	53.8

$\chi^2 = 41.35$ , 6 df,  $N = 196$ ,  $p < .05$ .

O'Malley, a fellow participant in the NIAAA-sponsored program that resulted in this supplement and a consultant in the writing of this article.

The Core Survey is designed to assess various factors related to college students' use of alcohol and other drugs. The four-page questionnaire addresses 39 topics in content areas such as demographics, usage patterns, perceptions of the campus environment, campus climate, campus violence and negative consequences that result from substance use. Reliability and validity data are available and have been described elsewhere (Presley et al., 1993a).

Schools with various heavy episodic drinking rates were identified by determining the overall heavy episodic drinking percentage at each school and then assigning the lowest third of schools to the low heavy episodic drinking (Low HED) category, the middle third to the medium heavy episodic drinking (Medium HED) category and the highest third to the high heavy episodic drinking (High HED) category. For purposes of this presentation, we are operationally defining "heavy episodic drinking" as the consumption of five or more drinks in a row in the previous 2 weeks. The percentage of students who reported heavy episodic drinking in the previous 2 weeks ranged from 9.5% to 39.1% in Low HED schools, from 39.2% to 51.5% in Medium HED schools and from 51.6% to 71.3% in High HED schools.

We then looked at the variable "size of institution" to see how the different types of schools aligned themselves. Using a chi-square analysis, we found no significant relationship with this variable (unlike the relationship with quantity measures noted above). The same was true for public/private status and for immediate location (inner city, other urban, suburban, rural, other). However, there were significant differences by regional location, with the majority of High HED schools located in the Northeast, a plurality of Medium HED schools located in the North Central states and a plurality of Low HED schools located in the South (Table 1).

We then conducted several analyses of variance looking at a number of items on the Core Alcohol and Drug Survey to see how the proportion of students in various demographic categories varied among the Low HED, Medium HED and High HED schools (Table 2).

TABLE 2. Mean percentages of students as a function of category of school

Variable	Category of school			ANOVA	
	Low HED	Medium HED	High HED	F (df)	p<
Greek member	10.8	15.2	17.2	4.301 (2/198)	.015
Age <21	54.8	61.8	64.3	7.427 (2/200)	.001
Male gender	36.7	41.2	42.9	4.951 (2/200)	.008
White	68.0	84.2	89.9	30.936 (2/200)	.000
Living on campus	49.1	59.2	65.6	6.607 (2/200)	.002
Fraternity housing	1.2	2.6	3.2	4.225 (2/200)	.016

Note: HED = heavy episodic drinking.

Based on these univariate analyses, some statements can be made about the presence of different types of groups that constitute the campus culture. Compared with Low HED and Medium HED schools, at those schools designated as High HED, more students on average belong to a fraternity or sorority, more of the student body is underage, more of the students are white, more of the students live on campus and more fraternity housing is available.

In this brief demonstration on the single variable called heavy episodic drinking, there is support for some of the research findings both in single institution studies and multi-institution studies with regard to demographic and environmental factors influencing collegiate drinking. This type of analysis represents a promising approach that can be employed with other types of variables or campus drinking typologies.

However, it may be useful to take this a step further and conduct multivariate logistic regressions predicting High HED institutions (versus Low HED and Medium HED institutions). Such a procedure was performed utilizing the univariate predictors described in the analysis above. The overall model chi-square was significant ( $\chi^2 = 55.06$ , 6 df,  $p < .0001$ ), but the only significant predictors (based on the Wald test and significant odds ratios [ORs] at the 95% confidence interval) were male gender (OR = 1.05; range: 1.02-1.08) and white race (OR = 1.18; range: 1.06-1.18).

These analyses indicate that institutions with a larger proportion of males are 1.05 times more likely to be High HED institutions. Institutions with a large majority of white students were approximately 1.2 times more likely to be High HED institutions.

The same analyses were performed to predict Low HED institutions (versus Medium HED and High HED). Although the model was significant, even for Low HED institutions, only male gender and white race were significant predictors. Institutions with Low HED rates were slightly less likely to have a high percentage of male and white students. Although previous analyses have indicated that blacks and whites at historically black institutions consumed less alcohol than blacks and whites at predominantly white institutions, an analysis was performed to determine the level

of heavy episodic drinking by nonwhites at the three categories of institutions (Low HED, Medium HED and High HED). A cross-tabulation was performed between heavy episodic drinking by minority students and the heavy episodic drinking level of the institution ( $N = 17,165$ ). The resulting chi-square was significant ( $\chi^2 = 477.30$ , 2 df,  $p < .001$ ). The heavy episodic drinking percentages for nonwhites at the Low HED, Medium HED and High HED institutions were 23.9%, 32.8% and 43.7%, respectively. Minority students at Low HED, Medium HED and High HED institutions engaged in heavy episodic drinking practices in environments that foster that behavior, although their rate of heavy episodic drinking was lower than that of white students.

#### *Campus community property variables*

Every college or university has an institutional culture that differs from that of every other institution, whether it is based on student demographics, entrance requirements, cost, traditions, competitiveness, athletics, size or region of the country. However, there are some other external environmental variables that may influence drinking. These factors include the availability of alcohol, pricing, density of distribution outlets (i.e., bars and clubs) in the area surrounding the campus, the social settings where drinking takes place and campus customs. Such factors all play a role in shaping the drinking environment for students (Newman et al., 1991). It is not within the scope of this discussion to describe student- and peer-related factors that impact on the drinking environment, but rather to discuss environmental factors—community availability, pricing, server density—that affect student drinking behavior. As Sanford (1962) said, “If we are interested in understanding the institution, we must identify and appreciate how the external environment shapes the institution” (p. 73).

*Pricing.* Using statistical economic simulation techniques, Chaloupka (1993) found that increases in alcohol beverage prices would lead to substantial reductions both in the frequency of youth alcohol consumption and in heavy drinking among the young. In addition, utilizing the same technique and six nationally representative data sets, he found that alcohol use and motor vehicle accident mortality rates were negatively related to the cost of alcohol and concluded that college completion rates are positively related to this cost. Chaloupka found that the effects of excise tax hikes on drinking exceeded the effects of establishing the uniform legal drinking age of 21 in all states studied. In 1998, Chaloupka et al. (1998) expanded the concept of price and economic impact to include not only the monetary price of alcoholic beverages, but also a wide variety of other “costs” of drinking and heavy drinking, including time spent obtaining alcohol and legal costs associated with drinking-related behavior. This research

clearly demonstrates that increases in total cost can significantly reduce consumption and thereby many of the problems associated with alcohol use and misuse.

Although these studies were not specifically designed for assessment of university policies, they certainly pose interesting research questions with regard to pricing issues in and around the campus environment.

*Outlet density and drinking venues.* A concept that has risen to the forefront of the prevention research agenda entails going beyond some of the previously described factors related to drinking risk and looking at the environmental context of drinking (Clapp et al., 2000). Although there is no standard definition for drinking contexts, Clapp et al. (p. 141) utilized the Harford (1978) definition: “The antecedents of alcohol consumption are to be found in the interaction between the individual and his environment . . . the consumption of alcoholic beverages is situationally specific, rather than a trans-situational property of specific individuals” (p. 289).

In their study, Clapp et al. (2000) found that parties, dates and socializing and being with friends were the most common situations where students reported their last heavy drinking event took place. (In addition, for males, playing drinking games increased the likelihood of experiencing alcohol-related problems in these settings by a factor of five.) Similarly, in a broader national study of drinking contexts, Hilton (1991) reported that across all types of consumption patterns, the presence of coworkers, close friends and neighbors increased the amount of alcohol consumed. Hilton also found that men drank more than did women in bars and public places as well as at private parties.

Although the Clapp et al. (2000) study is a single institution collegiate study, it is well constructed and scientifically rigorous in its methodology. It explores some contextual variables that may engender risk for students on college campuses and also identifies protective factors. The authors strongly suggest that research into college student drinking should utilize both individual variables as well as the contextual variables antecedent to drinking.

According to Gruenewald (1999), research has shown three things: (1) population growth leads to a greater number of alcohol outlets, (2) greater numbers of outlets relate to greater alcohol use and (3) greater use results in alcohol-related problems. Although this research is mainly focused on the community setting, his description of the community is analogous to that which exists for many colleges. His research found that, when outlet concentrations increased and multiple drinking venues existed, both long-term and short-term drinking problems also increased. His research study is awaiting final publication, but his initial approaches describing availability, density and server training variables as community prevention strategies are preliminarily leading to reductions in injury, assaults and other alcohol-related negative consequences. This approach must be studied further to assess the impact on college student drinking.



The significance of this research is that bars, parties and Greek organization events appear to be a popular way for college students to socialize and engage in alcohol use and problematic use. Thus there may be some impact on student drinking if the number of on-campus and near-campus sites where students can drink can be reduced. Research suggests that increasing the cost per unit of alcohol would also help.

### **Conclusion: Research Issues and Implications**

There are many unresolved issues with regard to research in this field but one of the most basic is how to determine the extent to which student drinking can be attributed to particular factors in the educational setting. Logically, we should consider a model of prevention that addresses the environment, student campus culture and various individual factors to reduce high-risk alcohol use. In other words, we need a cogent model that brings all these factors together to make a complete picture.

Given the complexities of campus environments, and in defining components of these environments, it is somewhat difficult to firmly establish what are the most compelling environmental causative factors. Colleges and universities are embedded in an extraordinary number of environments as well as an ever-changing contemporary social scene and collegiate culture. Confounding the environmental issue, each college attracts students who choose on an individual basis to drink or not drink for a variety of reasons that have no relation to the collegiate environment.

A good deal of research on the collegiate population has shown that individual characteristics are not always the best predictors of safe and responsible drinking patterns. Identifying institutional variables such as size, public or private control and gender or racial makeup has provided researchers with an aggregated list of potential predictors. Although this helps, to date this research has proved to be of limited value. Rigorous analytical techniques applied to regression models and structural equation modeling have also contributed some as well, but not much more than the descriptive analyses provided by other, simpler studies. On a practical level, what we know may be interesting, but one cannot ordinarily use this knowledge to manipulate a college's characteristics for the sole purpose of changing the college's drinking culture.

One way of approaching the problem would be to attempt to match or equate college environments in some respects and see how they compare on other variables. This approach is workable with only a small number of variables; the impracticality of matching colleges on many variables becomes evident quickly when one looks at the potentially vast array of collegiate characteristics.

Another complicating factor in this line of inquiry relates to variations in the units of analysis that are employed.

Many different units of analysis have been identified, and these add richness to the field but also complicate the ability to make firm statements about what is known. For example, a unit of analysis can be the student, the institution, certain categories of students, certain types of institutions or particular categories of students within particular types of institutions. Another unit of analysis issue revolves around measures of alcohol consumption: Do we use quantity, or frequency, or a categorization of use based on quantity *and* frequency? The high-risk/heavy episodic drinking measure can be identified as four or more drinks in a sitting, five or more drinks in a sitting or more than five drinks in sitting; and the time frame for this can be 2 weeks or 30 days, depending on the study. Differing cut points and time frames can seriously affect the conclusions we reach. Thus, in multi-institutional samples where data are aggregated, it is not often easy and sometimes controversial to determine which units of analysis should be employed. At the same time, focusing on the simplest unit and focusing on answering one question at a time do not do justice to the complexity of relationships that may exist.

Despite the methodological inconsistencies and variations in the reported studies, there are commonalities in what is known. There exists incontrovertible evidence that many students drink often and some drink to harmful levels. There is consistent information regarding the negative consequences of drinking. There are regional differences, racial differences and gender differences. There are also differences relating to housing, athletics and Greek organization affiliation. More emphasis on multivariate techniques may be necessary to begin to capture the complexity here.

We believe that models need to be developed where the institution and the individual are examined in relation to each other. This means identifying relevant variables and producing study designs based on what is presently known from the college alcohol literature and also extending our grasp outward into areas traditionally handled by the fields of organizational behavior, community psychology, sociology and social psychology.

To further the discussion in this area and move the field forward, we offer some additional research suggestions:

- Since outlet density and pricing are shown to be highly correlated with drinking, studies need to be conducted that look at these factors with respect to colleges. Specifically, baseline studies on outlet density and pricing need to be conducted, and then analyses need to be performed that explore the relationship between density and pricing on the one hand and the presence of high heavy episodic drinking schools on the other hand.
- Studies need to be conducted in the area of "self-selection," that is, whether students perceive and accurately identify the "high heavy episodic drinking institutions" and self-select for matriculation at these institutions.
- Studies need to be conducted as to how prospective students arrive at their perceptions of institutions as having a high rate

of drinking. For example, are those perceptions based on word of mouth, *Playboy* magazine rankings of party schools, alumni reports, current students' reports, general reputation, accessibility to bars or tolerance of the administration?

- Studies need to be designed that assess the surrounding community's tolerance of drinking. For example, do the local outlets have a reputation for "easy carding" policies, penny "drink nights," ladies nights and other marketing activities intended to promote excessive drinking targeted at college students?
- Although research has been conducted in the area of students' perceptions of *other students' drinking*, research has not yet been conducted in the area of perception of the campus' drinking norm relative to *other campuses' drinking norms*. In other words, do students perceive their campus as having higher use, less use or about the same use as other college campuses and how does this relate to consumption? Such analyses have the potential to explain some of the variance from an institutional/environmental context.
- Although the environment and the context of drinking occasions is important, research that truly seeks to understand the nature of the problem on campuses must also include individual variables. For example, aside from perceptions regarding schools' reputations for heavy episodic drinking, the availability of alcohol and other factors noted above, what are students' individual beliefs about alcohol, drinking histories, developmental expectations and perceptions of risk, which may increase the probability of high-risk drinking patterns within the college setting?

The issue is complex, and addressing the problem is complicated. Models for a solution must be powerful enough so that we can arrive at cogent, integrated responses that will help us move forward.

## References

- ASTIN, A.W. *What Matters in College? Four Critical Years Revisited*, San Francisco, CA: Jossey-Bass, 1993.
- BRENNAN, A.F., WALFISH, S. AND AUBUCHON, P. Alcohol use and abuse in college students: I. A review of individual and personality correlates. *Int. J. Addict.* **21**: 449-474, 1986.
- CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING. *Campus Life: In Search of a Community*, Princeton, NJ: Carnegie Foundation for the Advancement of Teaching, 1990.
- CASHIN, J.R., PRESLEY, C.A. AND MEILMAN, P.W. Alcohol use in the Greek system: Follow the leader? *J. Stud. Alcohol* **59**: 63-70, 1998.
- CHALOUKKA, F.J. Effects of price on alcohol-related problems. *Alcohol Hlth Res. World* **17**: 46-53, 1993.
- CHALOUKKA, F.J., GROSSMAN, M. AND SAFFER, H. The effects of price on the consequences of alcohol use and abuse. In: GALANTER, M. (Ed.) *Recent Developments in Alcoholism*, Vol. 14: *The Consequences of Alcoholism*, New York: Plenum Press, 1998, pp. 331-346.
- CLAPP, J.D., SHILLINGTON, A.M. AND SEGARS, L.B. Deconstructing contexts of binge drinking among college students. *Amer. J. Drug Alcohol Abuse* **26**: 139-154, 2000.
- DEJONG, W., VINCE-WHITMAN, C., COLTHURST, T., CRETTELLA, M., GILBREATH, M., ROSATI, M. AND ZWEIF, K. *Environmental Management: A Comprehensive Strategy for Reducing Alcohol and Other Drug Use on College Campuses*, Newton, MA: Higher Education Center for Alcohol and Other Drug Prevention, Department of Education, 1998.
- ENGS, R.C. AND HANSON, D.J. The drinking patterns and problems of college students: 1983. *J. Alcohol Drug Educ.* **31**: 65-83, 1985.
- FROMME, K. AND RUELA, A. Mediators and moderators of young adults' drinking. *Addiction* **89**: 63-71, 1994.
- GRUENEWALD, P. The elephant in the room. *Prev. File Winter*: 17-20, 1999.
- HARFORD, T.C. Contextual drinking patterns among men and women. In: SEIXAS, F.A. (Ed.) *Currents in Alcoholism*, Vol. 4. New York: Grune & Stratton, 1978, pp. 287-296.
- HARFORD, T.C., WECHSLER, H. AND ROHMAN, M. The structural context of college drinking. *J. Stud. Alcohol* **44**: 722-732, 1983.
- HILTON, M. The presence of alcohol in four social situations: Survey results from 1964 and 1984. In: CLARK, W.B. AND HILTON, M.E. (Eds.) *Alcohol in America: Drinking Practices and Problems*, Albany, NY: State University of New York Press, 1991, pp. 280-289.
- JESSOR, R. AND JESSOR, S.L.. Adolescent development and the onset of drinking. *J. Stud. Alcohol* **36**: 27-51, 1975.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1997*, Vol. 1, NIH Publication No. 98-4345, Washington: Government Printing Office, 1998a.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1997*, Vol. 2, NIH Publication No. 98-4346, Washington: Government Printing Office, 1998b.
- KLEIN, H. Helping the college student problem drinker. *J. Coll. Student Devel.* **30**: 323-331, 1989.
- LEICHLITER, J.S., MEILMAN, P.W., PRESLEY, C.A. AND CASHIN, J.R. Alcohol use and related consequences among students with varying levels of involvement in college athletics. *J. Amer. Coll. Hlth* **46**: 257-262, 1998.
- LO, C.C. AND GLOBETTI, G. A partial analysis of the campus influence on drinking behavior: Students who enter college as nondrinkers. *J. Drug Issues* **23**: 715-725, 1993.
- MEILMAN, P.W., LEICHLITER, J.S. AND PRESLEY, C.A. Greeks and athletes: Who drinks more? *J. Amer. Coll. Hlth* **47**: 187-190, 1999.
- MEILMAN, P.W., PRESLEY, C.A. AND CASHIN, J.R. The sober social life at the historically black colleges. *J. Blacks Higher Educ.* **9**: 98-100, 1995.
- MEILMAN, P.W., PRESLEY, C.A. AND LYERLA, R. Black college students and binge drinking. *J. Blacks Higher Educ.* **4**: 70-71, 1994.
- MOOS, R.H. *The Human Context: Environmental Determinants of Behavior*, New York: John Wiley & Sons, 1976.
- NATIONAL CENTER FOR EDUCATION STATISTICS. *Trends in Enrollment in Higher Education by Racial/Ethnic Category: Fall 1982 through Fall 1992*, Publication No. NCES 94-104, Washington: Office of Educational Research and Improvement, Department of Education, March 1994, pp. 2-4.
- NEWMAN, I.M., CRAWFORD, J.K. AND NELLIS, M.J. The role and function of drinking games in a university community. *J. Amer. Coll. Hlth* **39**: 171-175, 1991.
- O'HARE, T.M. Drinking in college: Consumption patterns, problems, sex differences and legal drinking age. *J. Stud. Alcohol* **51**: 536-541, 1990.
- PASCARELLA, E.T. AND TEREZINI, P.T. *How College Affects Students: Findings and Insights from Twenty Years of Research*, San Francisco, CA: Jossey-Bass, 1991.
- PRESLEY, C.A., LEICHLITER, J.S. AND MEILMAN, P.W. *Alcohol and Drugs on American College Campuses: A Report to College Presidents. Third in a Series: 1995, 1996, and 1997*, Carbondale, IL: Core Institute, Southern Illinois University, 1998.
- PRESLEY, C.A., MEILMAN, P.W. AND CASHIN, J.R. *Alcohol and Drugs on American College Campuses: Use, Consequences, and Perceptions of the Campus Environment, Volume IV: 1992-94*, Carbondale, IL: Core Institute, Southern Illinois University, 1996a.

- PRESLEY, C.A., MEILMAN, P.W., CASHIN, J.R. AND LYERLA, R. Alcohol and Drugs on American College Campuses: Use, Consequences, and Perceptions of the Campus Environment, Volume III: 1991-93, Carbondale, IL: Core Institute, Southern Illinois University, 1996b.
- PRESLEY, C.A., MEILMAN, P.W. AND LYERLA, R. Alcohol and Drugs on American College Campuses: Use, Consequences, and Perceptions of the Campus Environment, Volume I: 1989-91, Carbondale, IL: Core Institute, Southern Illinois University, 1993a.
- PRESLEY, C.A., MEILMAN, P.W. AND LYERLA, R. Alcohol and Drug Use among Residents of Greek Houses. Discoveries: A Bulletin of the Core Institute (available from the Core Institute, Student Health Programs, Southern Illinois University at Carbondale, Carbondale, IL 62901), 1993b.
- PRESLEY, C.A., MEILMAN, P.W. AND LYERLA, R. Alcohol and Drugs on American College Campuses: Use, Consequences, and Perceptions of the Campus Environment, Volume II: 1990-92, Carbondale, IL: Core Institute, Southern Illinois University, 1995.
- SANFORD, N. Higher education as a field of study. In: SANFORD, N. (Ed.) The American College: A Psychological and Social Interpretation of Higher Learning, New York: John Wiley & Sons, 1962, pp. 31-73.
- SHORE, E.R., RIVERS, C. AND BERMAN, J.J. Resistance by college students to peer pressure to drink. *J. Stud. Alcohol* **44**: 352-361, 1983.
- STRAUS, R. AND BACON, S.D. Drinking in College, New Haven, CT: Yale Univ. Press, 1953.
- UPCRAFT, M.L. Today's first year students and alcohol. Paper prepared for the National Advisory Council on Alcohol Abuse and Alcoholism Subcommittee on College Drinking, Panel 1: Contexts and Consequences, National Institute on Alcohol Abuse and Alcoholism, Washington, DC, 1999.
- WALLACK, L. AND DEJONG, W. Mass media and public health: Moving the focus of change from the individual to the environment, Rockville, MD: Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism, 1995, pp. 253-268.
- WECHSLER, H. Press Release from the Harvard School of Public Health (available from the Harvard School of Public Health, College Alcohol Studies, 677 Huntington Avenue, Boston, MA 02115), 1995.
- WECHSLER, H., DAVENPORT, A.E., DOWDALL, G.W., GROSSMAN, S.J. AND ZANAKOS, S.I. Binge drinking, tobacco, and illicit drug use and involvement in college athletics: A survey of students at 140 American colleges. *J. Amer. Coll. Hlth* **45**: 195-200, 1997.
- WECHSLER, H., DAVENPORT, A., DOWDALL, G., MOEYKENS, B. AND COSTILLO, S. Health and behavioral consequences of binge drinking in college: A national survey of students at 140 campuses. *JAMA* **272**: 1672-1677, 1994.
- WECHSLER, H., DOWDALL, G.W., DAVENPORT, A. AND COSTILLO, S. Correlates of college student binge drinking. *Amer. J. Publ. Hlth* **85**: 921-926, 1995.
- WECHSLER, H., MOLNAR, B.E., DAVENPORT, A.E. AND BAER, J.S. College alcohol use: A full or empty glass? *J. Amer. Coll. Hlth* **47**: 247-252, 1999.
- WERNER M.J. AND GREENE, J.W. Problem drinking among college freshmen. *J. Adolesc. Hlth* **13**: 487-492, 1992.