Alcohol Use

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1 Development of Alcohol Use

Underage drinking is a commonly observed risk behavior during adolescence. Around 60–80% (Kraus & Nociar, 2016; Patrick & Schulenberg, 2014) of youth report alcohol use before the age of 18, indicating that the vast majority of adolescents have experimented with alcohol before they enter young adulthood. Although adolescents' alcohol use patterns largely vary between countries, underage drinking appears to be normative and might serve both a social and a developmental function. That is, the use of alcohol may sometimes be part of a peer culture, and an increase, or in contrast a decrease, in alcohol use could mark a developmental change such as the transition to high school or the start of a professional career (Schulenberg & Maggs, 2002). Nevertheless, drinking patterns are highly variable between adolescents with regard to onset, frequency, and quantity. Different drinking patterns can have different impacts on health. For example, binge drinking (i.e., drinking five or more drinks at one occasion) is generally seen as more problematic than drinking only one or two glasses at the weekend. This notion is supported by several studies that conclude that binge-drinking episodes may have negative consequences for adolescent development (Carbia, López-Caneda, Corral, & Cadaveira, 2018). Moreover, early onset of drinking (before the age of 14 years) has been associated with more heavy and problematic use and alcohol dependence later in life (Hingson, Heeren, & Winter, 2006). Thus, although moderate alcohol use might be seen as normative and part of adolescent development, individual differences in drinking patterns can explain why alcohol use becomes problematic for some. This entry provides an overview of adolescent alcohol use by discussing typical trajectories of alcohol use, personality and behavioral characteristics that predict problematic alcohol use, possible consequences of (severe) alcohol use, and the influence of the social context on alcohol use.

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2 Trajectories of Drinking Behavior From Early to Late Adolescence

In the study of alcohol use, trajectories provide useful insight into the individual differences that exist in patterns of alcohol use during adolescence. For instance, latent growth modeling (i.e., variable centered) and latent transition modeling (i.e., person centered) have often been used to identify distinct groups based on the timing of alcohol use as well as similarity in drinking patterns (e.g., stable, decrease, or increase) during adolescence (Muthén & Muthén, 2000). In early to late adolescence, age of onset, *peaking level*, and persistence of use into young adulthood are considered the most relevant, important, and significant differences in individual alcohol use trajectories (Brown et al., 2008). That is, both time of onset and persistent (heavy) use into young adulthood are important markers for later problematic alcohol use and dependence (Hingson et al., 2006). Although there is variability between studies aiming at identifying types of alcohol use trajectories, adolescents and young adults typically fall into the following groups: early onset, late onset, moderate drinking, and (almost) nondrinking. Sometimes a *fling* trajectory is found, representing individuals who only engage in drinking during certain phases of adolescence, and for instance "mature out" of drinking (Brown et al., 2008; Maggs & Schulenberg, 2005). On average, adolescents start to experiment with drinking between the ages of 14 and 16 years. For some this results in a sharp increase or onset of alcohol use while others continue to consume one or two glasses on specific occasions. A distinction between drinkers and (almost) nondrinkers is clearly observed around mid- and late adolescence (16–18 years). Adolescents who continue drinking after initial experimentation tend to develop a more consistent drinking style around 16–18 years while those adolescents who abstain from regular alcohol use demonstrate consistently low levels of alcohol use. Although late onset drinkers start relatively late with alcohol use, they tend to increase their use rapidly.

3 Neurocognitive Development

The transition from childhood to adolescence is accompanied by several social and behavioral changes. These social and behavioral changes appear to play an important role in the increase in risk behavior, such as alcohol use, that is typically observed in midadolescence (14–16 years; Nelson, Van Ryzin, & Dishion, 2015). With the onset of puberty, adolescents become more aware of, and sensitive to, their social environment. There is increased attention to the opinions of others, attainment of social status becomes more important, and peer influence increases (Crone & Dahl, 2012). This peer-oriented focus parallels cognitive changes, such as an increase in sensation seeking, an increase in (social) reward sensitivity, and not yet fully developed behavioral control skills. The pronounced sensation-seeking tendencies in early adolescence (12–14 years) are probably directly associated with hormonal changes (Forbes & Dahl, 2010). Relative to childhood and adulthood, adolescence marks a period in which the brain is highly flexible and adaptive to the environment. This increased flexibility is thought to be at the expense of more protracted long-term control over behavior (Crone & Dahl, 2012; Spear, 2013). Behavioral control skills, especially in emotional and

arousing contexts, continue to develop until young adulthood in a process often known as *adaptive learning*. It has been suggested that particularly during adolescence the brain might be designed to support exploratory behavior, and inhibition of emotionally arousing or novel stimuli could undermine this exploratory behavior (Casey, 2015; Spear, 2013). Nevertheless, in relation to risky behaviors such as alcohol and drug use, for some adolescents this exploratory behavior could increase the risk for problematic use later in life.

Together, these social and cognitive changes provide a possible explanation for the increase in alcohol use in midadolescence. However, this theory of risk behavior does not reflect or explain within- and between-group differences in trajectories of alcohol use in adolescence. As such, additional explanatory mechanisms are necessary to do justice to the many trajectories of alcohol use that are observed in adolescence and young adulthood, and to specifically unravel the differential mechanisms underlying problematic and nonproblematic adolescent alcohol use.

4 Predictors of (Problematic) Alcohol Use

Cognitive and Interpersonal Processes

Affective processes (e.g., reward, salience, arousal, emotions) play an important role in adolescent alcohol use. Both positive and negative affective experiences with alcohol intoxication (e.g., peer acceptance vs. hangovers) influence alcohol-associated learning processes, which in turn influence future decisions to use alcohol. However, the propensity for positive and negative alcohol-use-related experiences and the subsequent learning processes are influenced by individual differences in underlying predispositions such as certain needs or motivational states (e.g., enhancement, reward seeking, or coping; Cooper, Agocha, & Sheldon, 2000) and mental health (e.g., depression, externalizing behavioral problems). Affective states can differ between individuals as well as between situations. Basic-level differences in arousal (low vs. high), for instance, have more often been observed in combination with specific behavioral styles such as impulsiveness or sensation seeking. Moreover, certain situations can trigger an affective state that impacts expectancies, goals, or motivations to engage in drinking behavior. For instance, the presence of peers can increase the anticipated reward of engaging in drinking behavior (Chein, Albert, O'Brien, Uckert & Steinberg, 2011). Therefore, drinking with or without peers might result in different anticipated rewards of alcohol use. In addition, the anticipated reward of drinking with peers might be stronger for adolescents who already have a relatively strong tendency to search for arousal and reward. The anticipated reward might therefore depend on the context as well as on individual differences.

Individual differences in anticipated reward can be related to particular personality styles. Roughly speaking, behavioral styles can be distinguished into two types that have been regularly linked to problematic alcohol use: (1) an undercontrolled or disinhibited behavioral style and (2) an overcontrolled or inhibited behavioral style. An undercontrolled or disinhibited behavioral style is often associated with high impulsivity or high sensation-seeking tendencies. Undercontrolled individuals often experience problems with inhibiting inappropriate responses and are more inclined than others to search for rewarding situations. In relation to alcohol use, these individuals

might experience the use of alcohol as more rewarding than peers who have a more controlled behavioral style. In general, adolescents more so than adults have the tendency to weigh immediate rewards as more important than long-term outcomes (Defoe, Dubas, Figner, & Van Aken, 2015). In combination with a sensation-seeking personality style, this naturally occurring tendency to search for reward in adolescence might place sensation-seeking adolescents at particular risk for early and persistent heavy alcohol use (Quin & Harden, 2013). Similarly, adolescents who are impulsive and have difficulties regulating their responses start drinking at an earlier age than their peers, and are less able to control their drinking behavior (Peeters et al., 2015). In this way, the normative increases in risky behaviors such as alcohol use might be more pronounced in adolescents who either have difficulties in regulating their behavior or who search for sensation and reward more than their peers. Disinhibited behavior is also observed among adolescents with externalizing behavioral problems. For example, adolescents with attention-deficit/hyperactivity disorder often have difficulties with behavioral control, most likely resulting from impaired executive control functions (e.g., inhibition, working memory, attention; Barkley, 1997). Moreover, other externalizing behavioral problems, such as conduct disorder or antisocial behavior, share behavioral commonalities, expressed in behavioral undercontrol, that increase the risk for problematic alcohol use (Dick et al., 2010).

Overcontrolled behavioral styles such as those seen in (social) anxiety and social phobia also have been associated with alcohol use. Socially anxious individuals tend to avoid social situations or situations that can trigger aversive feelings or emotions. One plausible explanation for the positive relation between (social) anxiety and alcohol use is that alcohol use weakens the aversive feelings and emotions experienced by anxious individuals (Kushner, Abrams, & Borchardt, 2000). This process, also known as *self-medication* or *coping*, increases the risk for problematic alcohol use by negative reinforcement; that is, alcohol use removes aversive consequences and as such increases the likelihood that the behavior will occur in the future. It is important to note that not all anxiety disorders have the same relationship with alcohol use. For instance, generalized anxiety is related to early onset of alcohol use while separation anxiety decreases the risk for early onset use (Kaplow, Curran, Angold, & Costello, 2001). Moreover, developmental stage may moderate the relationship between anxiety and alcohol use. For instance, high anxiety sensitivity, a risk factor for the development of an anxiety disorder, has been associated in early adolescence (12–14 years) with a lower risk for early initiation of alcohol use, while in late adolescence (18–20 years) anxiety sensitivity predicts alcohol use disorder (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Schmidt, Buckner, & Keough, 2007). These findings may extend to other psychopathologies and suggest that the relation between mental health and alcohol use in adolescence is complex, and that some individual characteristics have differential impacts depending on the development stage of drinking behavior (e.g., initiation, experimenting, persistent use).

Social Processes

As mentioned in the above sections, peers play a crucial role in adolescents' drinking behavior. Peer norms about what is accepted with respect to alcohol use influence adolescent drinking behavior. More specifically, peer groups that hold more positive norms about heavy drinking or intoxication (e.g., "drinking is cool") are more likely to reinforce

drinking behavior than peer groups that hold more neutral or negative norms about heavy drinking (Rambaran, Dijkstra, & Stark, 2013). In addition, popular peers tend to have a greater influence on adolescents' drinking behavior compared to less popular peers (de Water, Burk, Cillessen, & Scheres, 2017). However, not all adolescents are similarly susceptible to the influence of peer processes.

As social environments (e.g., school, family, friends) change during adolescence, the influence of peers on drinking behavior might also differ during particular phases of adolescence (Kuntsche, Rehm, & Gmel, 2004). It is therefore important to study trajectories of alcohol use into emerging adulthood. Heavy drinking patterns in midadolescence are generally associated with heavy drinking patterns in adulthood (Wells, Horwood, & Fergusson, 2004). However, for some individuals, drinking behavior might decrease once they get a job or a romantic relationship, while others suddenly increase their drinking behavior in late adolescence. Fromme, Corbin, and Kruse (2008), for instance, found that drinking behavior in late adolescence increased as a result of entering college life. The results of this study suggested that the college culture triggers an increase in alcohol use. The *transition catalyst model* describes alcohol use as a possible "catalyst of change." Alcohol use might serve a need with respect to developing new social networks and bonding with peers (Schulenberg & Maggs, 2002). Bonding with peers and establishing and strengthening social relationships might be particularly relevant when entering into a new social context such as college life. In contrast, adolescents who enter work life might reveal an opposite developmental pattern. "Maturing out of alcohol use" (Ashenhurst, Harden, Corbin, & Fromme, 2015) refers to the developmental process characterizing adolescents and young adults who tend to drink relatively heavily during adolescence but reduce their drinking behavior as soon as they enter adult life and come into contact with adult roles such as work, romantic relationships, and cohabitation. In this situation, the changing social context seems to demand responsibilities that are incompatible with uncontrolled drinking behavior. Either way, the social context appears to be a crucial trigger of change.

5 Consequences of (Problematic) Alcohol Use

Cognitive and Interpersonal Outcomes

Cognitive development continues until late adolescence and young adulthood (around 22 years; Blakemore & Choudhury, 2006). One of the most impactful concerns raised in the field of adolescent alcohol use is that alcohol use during adolescence could harm cognitive development. Some studies examining alcohol-dependent and abusing adolescents indeed show alarming consequences of alcohol use on the adolescent brain; however, it is not yet clear whether these findings generalize to the wider adolescent population (Peeters, Vollebergh, Wiers, & Field, 2013). Moreover, some of these cognitive impairments already appear to be visible before alcohol use onset, raising the "chicken or egg" issue (Whelan et al., 2014). Some studies suggest that certain drinking patterns are more harmful than others. Squeglia, Spadoni, Infante, Myers, and Tapert (2009), for instance, found a positive relation between cognitive impairments in adolescents and the reported number of hangovers. Studying animal behavior, Crews, Braun, Hoplight, Switzer, and Knapp (2000) found more harmful effects of binge drinking in adolescent rats compared to adult rats. Results of studies investigating the

consequences of adolescent drinking appear to point to the direction of more harmful effects and related cognitive impairments of heavy episodic (binge) drinking. However, clear causal evidence of cognitive impairment after (heavy) drinking in adolescents is currently lacking.

An early onset of drinking behavior has been associated with more problematic alcohol use later in life and an increased risk for later development of addiction (DeWit, Adlaf, Offord, & Ogborne, 2000). Several possible explanatory mechanisms have been proposed to account for the increased risk for addiction in relation to an early onset of drinking. First, some argue that early onset of use is an aftereffect of already existing predispositions such as psychopathology, genetic composition, or temperament. However, the role of genes in explaining variation in adolescent alcohol use appears to be relatively small. Twin studies, for instance, reveal that variation in experimenting with and frequency of drinking is not strongly explained by genes. Genetic impact seems to be larger in explaining problematic (mis)use (Geels et al., 2012; Poelen et al., 2008). Second, it has been proposed that onset of alcohol use in early adolescence coincides with heightened susceptibility to influences from the environment (peers, friends), resulting in interference with social and cognitive learning processes. When adolescents consume their first drink and experience a positive association with this behavior, it is more likely that they will continue this behavior in the future (i.e., positive reinforcement). That is, reinforcement learning might be stronger in adolescents than in adults (Cousijn, Luijten, & Ewing, 2018). Adolescents have a heightened susceptibility to the influence of peers, and hormonal changes (triggered by puberty onset) might amplify certain cognitive processes (e.g., testosterone levels, sensation-seeking behavior; Braams, Van Duijvenvoorde, Peper, & Crone, 2015), increasing the positive (social) reinforcing value of alcohol use. Future decisions to engage in alcohol use could be influenced by these early drinking experiences. Although these learned associations indeed predict future alcohol use in adolescents (Thush et al., 2008), drinking behavior does not seem to strengthen or change these associative learning processes in adolescence (Peeters et al., 2013). Similarly, some studies have found preexisting alcohol associations in nondrinking adolescents (Van Der Vorst et al., 2013), suggesting that the environment (e.g., home, friends, media) plays an important role in associative learning processes.

Social Outcomes

The social development model (Catalano, Kosterman, Hawkins, Newcomb, & Abbott, 1996) proposes that early involvement in antisocial behaviors in adolescence, including heavy drinking, impedes prosocial socialization later in life. According to this perspective, heavy drinking might increase the likelihood of negative outcomes later in life. Research indeed shows that adolescents with heavier drinking trajectories often experience more negative (health) outcomes later in life, such as lower education, homelessness, lower social class, and higher school dropout (Viner & Taylor, 2007; Wells et al., 2004). Nevertheless, the causal effect of heavy (binge) drinking in adolescence on later adverse health outcomes is far from straightforward. That is, heavy drinking in adolescence does not always result in negative or adverse outcomes in young adulthood. It often depends on the developmental course of heavy drinking. A late but rapid increase in heavy drinking might trigger more adverse health outcomes than an early heavy trajectory, declining again in late adolescence (Schulenberg, O'Malley, Bachman,

Wadsworth, & Johnston, 1996). Nevertheless, a clear relationship has been observed between early onset and substance (mis)use in young adulthood (Hingson et al., 2006).

An important issue to consider when looking at future health outcomes is the contribution of adolescent drinking behavior and its *unique* negative impact on these outcomes. Uncontrolled confounding variables can bias the relationship (McCambridge, McAlaney, & Rowe, 2011). For instance, psychosocial predispositions such as personality or socioeconomic status might already influence drinking behavior in adolescence and continue to have a negative impact on future health outcomes in young adulthood, or in contrast reveal a reversed association with alcohol use. For example, socioeconomic status has been found to be negatively related with alcohol use in early and midadolescence while in late adolescence socioeconomic status is positively associated with alcohol use (Brown et al., 2008). Such varying influences of the context might coincide with differences observed in trajectories of alcohol use. In addition, adverse outcomes such as unemployment might equally be a consequence as a cause of heavy drinking. Disentangling unique influences of drinking behavior on health outcomes is therefore of crucial importance in the near future.

6 Future Directions

Although individual differences impact the risk for problematic alcohol use in adolescence, interpersonal processes almost always seem to interact with the social environment. Alcohol use in adolescence can therefore only be fully understood when considering the social context in which alcohol use takes place. The direct (i.e., context influences drinking behavior) as well as indirect (i.e., context influences affective processes or temperament) influences of the social environment shape and reshape patterns of alcohol use throughout adolescence and adulthood. Moreover, the impact of interpersonal and social processes on alcohol use might vary as a function of different developmental phases in adolescence (Maggs & Schulenberg, 2005).

There is a fine dividing line between the risks and the benefits associated with alcohol use in adolescence. Experimenting with alcohol use is part of adolescent development and might serve certain social needs and even benefit the transition to more adult roles (Brown et al., 2008). At the same time, the negative consequences of certain drinking styles should not be underestimated. There seems to be agreement on the negative impact that early onset of alcohol use as well as binge-drinking episodes have on adolescent development (Carbia et al., 2018). However, we should be cautious in assigning specific risks of alcohol use to adolescents in particular. Many of the negative consequences (e.g., associative learning, cognitive impairments) can impact adult drinking behavior as well, and it is not yet clear whether the adolescent brain is more vulnerable to alcohol use than the adult brain.

SEE ALSO: Behavioral, Cognitive–Behavioral, and Social Learning Approaches; Epidemiological Research in Adolescence; Impulsivity in Adolescence: Predictors and Consequences; Neurobiology of Risk Taking and Impulsivity; Peer Influence in Adolescence; Personality–Environment Interaction; Prevention of Risk Behavior; Social Influences on Adolescent Substance Abuse; Transition From Adolescence to Emerging Adulthood

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