Addictive Behaviors 33 (2008) 1344–1352

Contents lists available at ScienceDirect

Addictive Behaviors

Alcohol outcome expectancies and drinking motives mediate the association between sensation seeking and alcohol use among adolescents

Róbert Urbán [a,*], Gyöngyi Kökönyei [a], Zsolt Demetrovics [b]

[a] Eötvös Loránd University, Department of Personality and Health Psychology, Budapest, H-1064, Izabella u. 46, Hungary
[b] Eötvös Loránd University, Addiction Research Unit, Budapest, H-1064, Izabella u. 46, Hungary

ARTICLE INFO

Keywords:
Alcohol
Outcome expectancies
Drinking motives
Sensation seeking
Adolescence

ABSTRACT

Sensation seeking is a strong correlate of alcohol consumption among young people, yet the research on mediators of this association is mainly limited to English-speaking adolescents. The proposed model of the present study includes antecedent variables (sensation seeking, age and gender), mediators (positive and negative expectancies and drinking motives), and one outcome variable (a composite score of alcohol use). Self-reported data obtained from Hungarian high school students (N = 707, mean age 16.6, SD = 1.5) were analyzed with structural equation modeling. The general model fit was excellent, and this study supported the proposed sensation seeking → positive and negative expectancies → drinking motives → alcohol use indirect effects. The total indirect effect explains 38% of sensation seeking and alcohol use association. Results support the notion that positive expectancy mediates between sensation seeking and drinking motives, and finally, positive expectancy and drinking motives are mediators between sensation seeking and alcohol use.

1. Introduction

Novelty seeking and sensation seeking are recognized as well-established risk factors for health-impairing behaviors including legal and illegal drug use (Roberti, 2004; Staiger, Kambouropoulos, & Dawe, 2007; Zuckerman, 1994). Sensation seeking is associated with the frequency of alcohol use and the amount of alcohol consumption in all age groups (Hittner & Swickert, 2006). This research report aims to develop an explanatory model based on motivational theories of alcohol use for the association between sensation seeking and alcohol use among Hungarian adolescents.

Hungarian mortality data provide the evidence that Hungary is afflicted with the detrimental impact of alcohol use. The relative risk of alcohol-related mortality was 1.90 compared to the European Union in 2005 (Health For All Database, 2007). Moreover, there is an increasing trend in the quantity of alcohol consumption in Hungary, while in the European Union a clear decreasing trend of alcohol use can be observed (Health For All Database, 2007). In order to tackle these negative trends in the long term, studies on adolescent alcohol use are of crucial importance. As well as the higher mortality risk of alcohol use in the entire population, experimentation with alcohol, established alcohol use, or even underage problem drinking among high school students represents a major public health concern in view of the fact that adolescent alcohol use can result in harmful short- and long-term health, social, academic, legal, and financial consequences (Newburn & Shiner, 2001). According to the national report of Health Behaviour in School-aged Children (HBSC) survey, in Hungary 92% of 11th grade adolescents have already consumed alcohol, and 64% of boys and 41% of girls have already been drunk at least twice (Aszmann, 2003). Alcohol consumption in adolescence increases the risk of heavy drinking and alcohol dependence in young adulthood life and later (Andersen, Due,

* Corresponding author. Tel.: +36 30 565 2992; fax: +36 1 4612695.
E-mail addresses: urban.robert@ppk.elte.hu, rurban@hu.inter.net (R. Urbán), kokonyei@gmail.com (G. Kökönyei), demetrovics@t-online.hu (Z. Demetrovics).

0306-4603/$ – see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.addbeh.2008.06.006

Holstein, & Iversen, 2003). Research on alcohol consumption among adolescents should focus on distal and proximal variables that might explain the variance of drinking behavior in order to construct effective programs to influence alcohol use among teenagers.

1.1. Alcohol use, outcome expectancies, and drinking motives

The recent motivational models of alcohol use propose the alcohol-related outcome expectancies and drinking motives as mediators between antecedents and alcohol use behavior (see for review Kuntsche, Knibbe, Gmel, & Engels, 2005).

The alcohol-related outcome expectancies are defined as beliefs about the effects of alcohol on behavior, cognition, moods, and emotions (Leigh, 1989). These beliefs play a particularly important role at the age when experiences with alcohol are less advanced. Young children's expectancies of alcohol are best described as indeterminate and diffuse. Their beliefs "crystallize" with age (Miller, Smith, & Goldman, 1990). Parental behavior, interaction with peers, and media representation of alcohol direct the formation of alcohol-related outcome expectancies (Martino, Collins, Ellickson, Schell, & McCaffrey, 2006). Moreover, these expectancies influence not only the behavior but also the actual perception of later experiences with alcohol, which then, in turn, may strengthen the original expectancies (Oei & Morawska, 2004).

Alcohol-related outcome expectancy research emphasizes the importance of both implicit cognition or memory activation and explicit expectancy in understanding alcohol use (e.g. Rather, Goldman, & Roehrich, 1992; Wiers, van Woerden, Smulders, & de Jong, 2002). Research on explicit alcohol-related outcome expectancy applied factor analysis and identified two weakly correlated outcome expectancy second-ordered factors, namely positive and negative outcome expectancies (Leigh & Stacy, 1993). While positive expectancy includes the positive and negative reinforcing properties of alcohol, negative expectancy embraces the expected negative consequences of alcohol use. Studies on implicit alcohol-related cognitions applied the semantic memory network model and multidimensional scaling, and revealed two factors, namely social/positive versus antisocial/negative and arousing versus sedating (Rather et al., 1992).

Stacy (1997) demonstrated that memory activation and explicitly generated outcome expectancy were independent prospective predictors of alcohol use. The implicit cognitive components are those memory associations which can be easily activated by situational or motivation circumstances; the outcome expectancy, on the other hand, may be involved in the explicit decision-making process about alcohol use. Stacy (1997) also reported that the positive outcome expectancy correlated positively with impulsive sensation seeking, whereas the memory activation did not. Therefore, sensation-seeking traits might have an impact on explicit decision-making about alcohol use, but is not related to the accessibility of alcohol-related memory components. Consequently, this present research focuses on explicit alcohol-related outcome expectancies only.

The other cognitive-motivational predictors of alcohol use are drinking motives, which are regarded as the final common pathways to alcohol use, through which more distal determinants—i.e. personality determinants and outcome expectancies—exert their influences on behavior (Kuntsche et al., 2005). Cooper's (1994) results provide support for the four-factor model of drinking motives based on the conceptual model of Cox and Klinger (1988). Cooper's (1994) model includes social, coping, enhancement, and conformity motives, and the theoretical structure of the operational model is supported in different age groups, among boys and girls, and in English and non-English samples (Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2006). A recent study provided evidence that drinking motives are the gateway through which alcohol-related expectancies are almost fully mediated in Swiss adolescents (Kuntsche, Knibbe, Engels, & Gmel, 2007).

In the present study, a sensation-seeking personality trait is regarded as an antecedent individual variable which has an impact on expectancies. It also influences drinking motives which finally determine alcohol use. Therefore, we propose that drinking motives can be mediators between alcohol outcome expectancies and alcohol use.

1.2. Sensation seeking, alcohol use, and expectancies of alcohol

Individual factors might either foster or weaken the development of alcohol-related outcome expectancies, therefore several personality factors were studied in relation to alcohol use and alcohol expectancy. For example, McCarthy, Kroll, & Smith (2001) empirically supported the claim that disinhibition—operationalized as neurotic extraversion—is related to alcohol use and alcohol expectancies among undergraduate students; moreover, positive expectancies mediate the influences of disinhibition on drinking behavior. The other personality variable which is frequently studied in relation to drug use is a sensation-seeking trait. Sensation seeking is described as the tendency of "seeking of varied, novel, complex, and intense sensations and experience, and the willingness to take physical, social, legal and financial risks for the sake of such experience" (Zuckerman, 1994, p. 27). The association between sensation seeking and alcohol use is well documented. In a recent meta-analysis the effect size of this association in an adolescent population was r=.296 (Hittner & Swickert, 2006). Although the correlation between sensation seeking and alcohol use is well-established, the explanation for this association requires further examination.

Only relatively few studies have tested the assumption that outcome expectancies and drinking motives might explain the association between sensation seeking and alcohol consumption. If this assumption is true, high sensation seekers expect more positive and less negative consequences related to alcohol consumption, and report higher drinking motives in certain situations. Several studies (Darkes, Greenbaum, & Goldman, 2004; Finn, Sharkansky, Brandt, & Turcotte, 2000; Henderson, Goldman, Coovert, & Carnevalla, 1994) have demonstrated that the alcohol expectancies mediate partially but significantly the association between sensation seeking and alcohol use. These studies tested alcohol-related positive expectancies only, and their samples included young adults or college students. In contrast, Katz, Fromme, and D'Amico (2000) found that, on the one hand, there is a positive relationship between sensation seeking and positive expectancies and, on the other hand, that there is a negative correlation

between sensation seeking and risk expectancies in the case of heavy drinking. The authors concluded that outcome expectancies do not mediate the association between sensation seeking and heavy drinking among college students.

Only a few studies have tested the assumption that drinking motives can be also mediators of the association between sensation seeking and alcohol use. A very recent study differentiating sensation seeking from impulsivity presented evidence that enhancement motives partially mediated the sensation seeking and alcohol use association, and coping motives mediated between impulsivity and alcohol problems among college students (Magid, Maclean, & Colder, 2007); however, we could not identify any previous study that had tested this mechanism among high school students.

There is not enough research to reach a firm conclusion regarding the mediating role of outcome expectancies between sensation seeking and alcohol use in an adolescent population. To support the notion that outcome expectancies and drinking motives can be mediators is critical not only for theoretical reasons, but this mediation can be a central target in prevention strategies of alcohol use or alcohol problems either among adolescents or in a more focused way among high sensation-seeking adolescents.

1.3. The present study

In the present study, we hypothesized that positive and negative outcome expectancies and drinking motives, at least partially, mediate the association between sensation seeking and alcohol use in a high school population. We propose a complex mediation, in which age, gender, and sensation seeking represent the antecedent variables of alcohol use, positive expectancy, negative expectancy, and drinking motives serve as the mediator variable and, finally, alcohol use is the outcome variable. The model is presented in Fig. 1.

2. Method

2.1. Participants and procedure

Twenty-five general high schools were invited to participate in the study, of which two refused. Schools were selected to represent a wide variety of high schools in terms of location and socioeconomic characteristics of their neighborhood. For each high school, one or two classes were randomly selected. The participants were asked to complete the questionnaire in their classrooms within one class session, therefore the sample characteristics reflects the composition of the participating classes. Subjects were informed both verbally and in a written form that participation in the study was voluntary and anonymous. Of the 773 students who answered the questionnaire, data for 23 participants were dropped because of the extremely high number of missing values. A further 43 participants were excluded from the analyses since they reported not drinking alcohol during the last 12 months, and thus they were not eligible to answer the questions regarding drinking motives. The final sample is composed of 707 high school students from 23 high schools (mean age = 16.7 years, SD = 1.50 years, age range 14–20; 277 boys and 430 girls). The higher proportion of girls in this sample is in accordance with gender distribution in general high schools in Hungary (Ministry of Education and Culture, 2006).

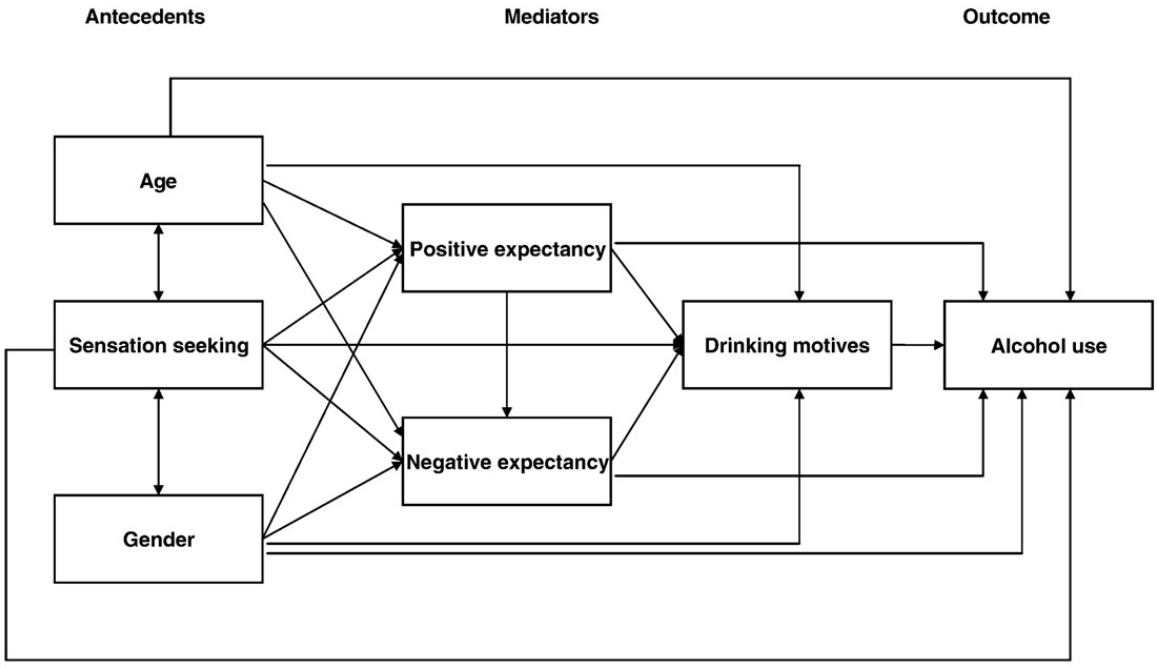

Fig. 1. The model which describes the associations between sensation seeking, alcohol-related positive expectancy, drinking motives, and alcohol use.

2.2. Measures

2.2.1. Alcohol use

Alcohol consumption was assessed using seven alcohol-related items that included questions related to lifetime alcohol use, frequency of alcohol use during the last 12 months and in the last 30 days, lifetime frequency of being drunk, frequency of being drunk in the last 12 months and in the last 30 days, and, finally, frequency of having at least five or more alcoholic drinks in a row. These questions were selected from alcohol use measures of the European School Survey Project on Alcohol and Other Drugs research (Hibbel et al., 2004); the questions related to types of alcoholic beverage were not included in this research.

2.2.2. Alcohol outcome expectancies

The Alcohol Outcome Expectancy Questionnaire (Leigh & Stacy, 1993) was used to measure positive and negative outcome expectancies. This 34-item scale contains the four positive outcome expectancy scales: social facilitation, fun, sex, and tension reduction and the four negative outcome expectancy scales social, emotional, physical, and cognitive performance. Both positive and negative expectancies presented good internal consistency (Cronbach's α=.94 and .88, respectively) in the original publication (Leigh & Stacy, 1993). We performed a confirmatory factor analysis on this present data set, and the analysis shows a good fit to the original structure (CFI: .975; IFI: .975; TLI: .971, RMSEA: .062). Positive and negative expectancies were computed with the sum of relevant items.

2.2.3. Drinking motives

Drinking motives were measured by the Drinking Motives Questionnaire (DMQ-R) (Cooper, 1994), which is a 20-item questionnaire that assesses four categories of drinking motives (social, coping, enhancement, and conformity). Each motive is measured by five items that ask how often the respondent drinks for the given reason. The structure of DMQ-R was supported in a Swiss adolescent sample (Kuntsche et al., 2006). A confirmatory factor analysis supported the original four-factorial structure in the present Hungarian sample (CFI: .934, IFI: .934, TLI: .915, RMSEA: .105).

2.2.4. Sensation seeking

The Sensation Seeking Scale form V (SSS-V) (Zuckerman, 1994) is a 40-item forced choice questionnaire which yields four subscale scores, each consisting of ten items, and a total score. The SSS-V has good internal consistency and an excellent convergent validity with related constructs (Zuckerman, 1994). SSS-V has been criticized in alcohol research because it contains some items that refer explicitly to the willingness of using alcohol and other drugs. For this reason we omitted these items and constructed a sensation-seeking score without them (items 9, 10, 13, 30, and 36). The internal consistency and construct validity of the Hungarian version of SSS-V has been confirmed in several reports including studies on sensation seeking among juvenile delinquents (Nagy & Kulcsár, 1998), sensation seeking among illicit drug users (Demetrovics, 2007), and association between sensation seeking and media use in a community sample (Babocsay, 2002). The internal consistency was also found to be satisfactory in the present research (Cronbach's α=.76).

3. Results

3.1. Alcohol use

Adolescents in our sample reported relatively high levels of alcohol use as follows: 33% of participants had already drunk alcohol more than 40 times during their lifetime; 5% had consumed any kind of alcohol 10 times or more during the last 30 days; 7% had been drunk three or more times during the last 30 days; finally, 12% of the participants reported binge drinking three or more times during the last 30 days. Comparing these frequencies to the representative data for Hungarian adolescents from the most recent ESPAD study (Hibbel et al., 2004) revealed that our participants had more experience of alcohol. Since age and alcohol use positively correlate (r=.29; see Table 1) and the mean age of the present sample is higher than that of the comparison sample in the ESPAD research (16.6 versus 15.7 years, one sample t value=11.2, p<.001), the heavier alcohol use might be explained by the higher age in our sample. A further difference is that in our sample the percentage of girls is higher than the percentage of boys in the ESPAD sample (61% versus 48% χ^2=84.1, p<.001).

3.2. Data reduction

We performed a data reduction technique on alcohol use data with principal component analysis. This statistical technique is widely used to determine the linear combinations of the measured variables in order to retain as much information from the originally measured variables as possible (Fabrigar, Wegener, MacCallum, Strahan, & Becker, 1999). From the seven alcohol-related items, only one component was identified which explains 68% of the variance. The loading of the items ranged between .75 and .88. We refer to this principal component as the composite score of alcohol use or simply alcohol use in the Results section of this report, and the standardized score of the composite score of alcohol use will be used in the analyses. Since the skewness (.87) and kurtosis (.32) of the composite score of alcohol use deviate from the normal distribution, we applied logarithmic transformation to decrease this deviation (final skewness −.13; final kurtosis −.70). We report the statistical analysis with log transformed alcohol use score only when the result is different from the original score.

Table 1
Zero-order correlations, means and standard deviations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. Gender*+	–																		
2. Age	.03	–																	
3. Alcohol use**	**−.19**	**.29**	–																
4. Positive expectancies	.01	*.12*	**.47**	–															
5. Social facilitation	.06	**.13**	**.34**	**.88**	**–**														
6. Fun	.02	*.09*	**.52**	**.88**	**.67**	**–**													
7. Sex	*−.09*	**.13**	**.39**	**.79**	**.57**	**.57**	**–**												
8. Tension reduction	.03	.06	**.31**	**.77**	**.69**	**.64**	**.42**	–											
9. Negative expectancies	−.01	−.06	−.06	**.22**	**.21**	.06	**.25**	**.18**	–										
10. Social	**−.18**	−.04	.03	**.18**	**.14**	.07	**.26**	*.09*	**.67**	–									
11. Emotional	*.10*	−.01	**−.19**	*−.08*	.00	**−.21**	−.01	−.07	**.70**	**.33**	–								
12. Physical	.07	−.04	*−.08*	**.18**	**.15**	.05	**.20**	**.16**	**.82**	**.42**	**.51**	–							
13. Cognitive/performance	−.05	−.05	.04	**.32**	**.29**	**.20**	**.27**	**.25**	**.86**	**.47**	**.44**	**.55**	–						
14. Drinking motives**	−.01	**.13**	**.46**	**.58**	**.51**	**.55**	**.41**	**.43**	.06	*.09*	*−.11*	.07	*.09*						
15. Social motives	−.01	**.16**	**.57**	**.62**	**.55**	**.62**	**.43**	**.43**	−.04	.00	**−.21**	−.03	.06	**.86**	–				
16. Coping motives	.07	**.14**	**.40**	**.49**	**.43**	**.43**	**.35**	**.45**	*.10*	*.11*	−.02	.12	*.09*	**.79**	**.59**	–			
17. Enhancement motives	−.02	.07	**.55**	**.57**	**.43**	**.63**	**.42**	**.36**	−.02	.03	**−.19**	−.04	*.08*	**.82**	**.72**	**.56**	–		
18. Conformity	−.07	.06	*.12*	**.31**	**.35**	**.26**	**.21**	**.20**	**.17**	**.22**	.07	**.13**	*.12*	**.68**	**.49**	**.43**	**.42**	–	
19. Sensation seeking	**−.16**	.02	**.48**	**.33**	**.22**	**.38**	**.31**	**.20**	**−.13**	.02	**−.20**	**−.18**	−.04	**.30**	**.39**	**.25**	**.43**	*.10*	–
Mean	–	16.6	0.0	70	22.1	22.5	13.2	12.3	40.4	5.7	6.7	11.3	16.8		12.1	6.9	8.1	4.0	18.1
SD	–	1.5	1.0	17.4	5.9	6.1	5.6	3.2	12.4	2.8	3.1	4.3	5.6		6.3	5.9	6.2	4.3	5.8
Cronbach alpha	–	–	.80	.93	.85	.84	.92	.79	.88	.75	.88	.76	.80		.86	.87	.87	.80	.76

Note: $n = 707$. The bolded correlation coefficients are significant at least at $p < .0004$ according to Bonferroni correction. Correlations with italic are significant at least $p < 0.05$. *: point biserial correlation, +:male:1; female:2.**:Standardized score in which the mean is equal 0.00, SD = 1.00.

We also performed a principal component analysis on drinking motives' factors. Only one component was identified which explained 64% of variance. The loadings were between .68 and .87. The standardized composite score of drinking motives was used and is referred to as drinking motives.

3.3. Mediation analysis

We performed a path analysis with the AMOS 4.01 program, and maximum likelihood estimation was used to estimate the models. The proposed path model is depicted in Fig. 1.

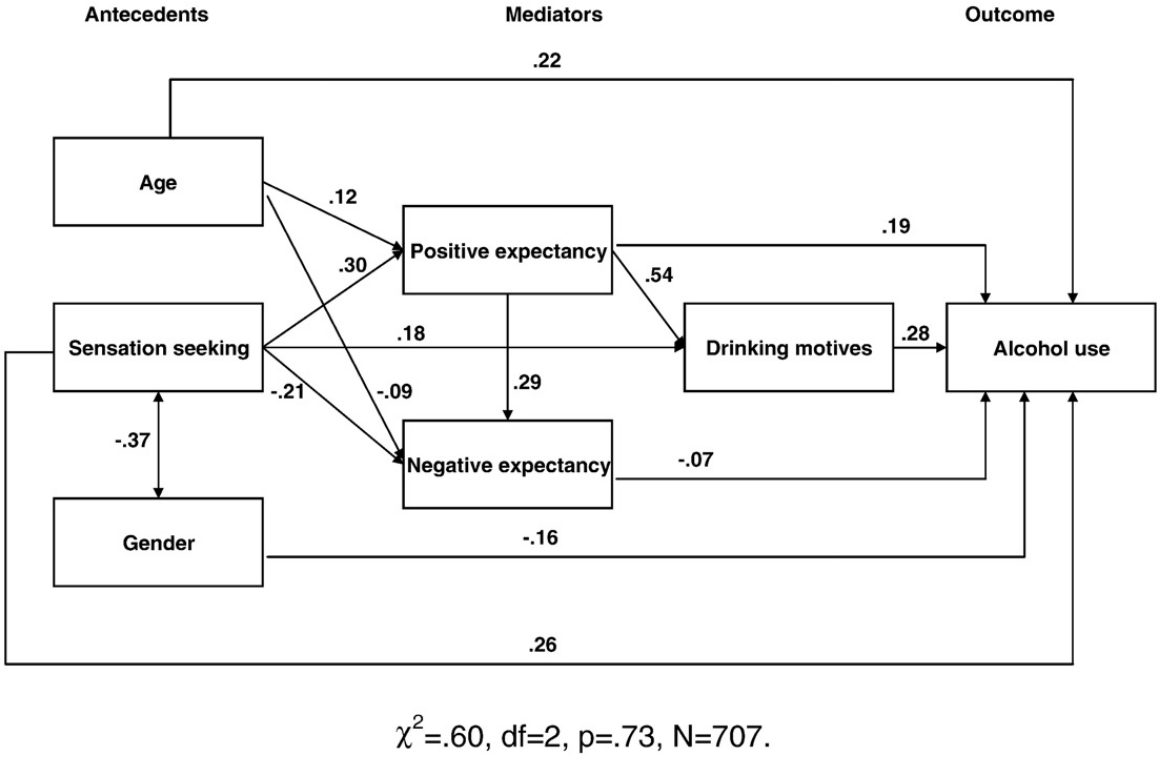

Fig. 2. The final path model which describing the associations between sensation seeking, alcohol-related positive expectancy, drinking motives, and alcohol use. Only the statistically significant standardized path coefficients are presented.

Table 2
Standardized estimates of direct and total indirect effects on alcohol use and mediator variables and their respective confidence intervals

Antecedent variables	Standardized direct effect [99% CI]	$p<$	Standardized total indirect effect [99% CI]	$p<$	Proportion of indirect effect*
Sensation seeking effect					
Sensation seeking → Positive expectancy	.29 [.21–36]	.004	–		
Sensation seeking → Negative expectancy	−.21 [−.30–−.12]	.004	.08 [.04–.13]	.004	29%
Sensation seeking → Drinking motives	.18 [.10–.25]	.004	.16 [.11–.20]	.004	47%
Sensation seeking → Alcohol use	.26 [.19–.34]	.004	.16 [.10–.19]	.004	38%
Age					
Age → Positive expectancy	.11 [.03–.20]	.004			
Age → Negative expectancy	−.06 [−.18–.02]	.03	.03 [.01–.07]	.004	33%
Age → Drinking motives	.06 [−.02–.17]	.05	.06 [.01–.11]	.004	50%
Age → Alcohol use	.22 [.14–.29]	.004	.06 [.02–.09]	.004	21%
Gender					
Gender → Positive expectancy	.00				
Age → Negative expectancy	−.04		.00		
Gender → Drinking motives	.00		.00		
Gender → Alcohol use	−.16 [−.24–−.09]	.004	.01 [−.01–.04]	.23	0%

*Proportion of indirect effect = total indirect effect * 100/(total indirect effect + direct effect).

The fully saturated model was estimated in order to provide a more conservative test of the expected indirect pathways. The exogenous variables sensation seeking, gender, and age were allowed to covary. Table 1 presents zero-order correlations, means, and standard deviations of study variables. Since there is a large set of correlations, in accordance with the Bonferroni procedure, a stricter decision criterion ($p<.0004$) was used to determine the statistical significance. Covariance between sensation seeking and age has recently been suggested to be curvilinear, which shows a peak during adolescence (Romer & Hennessy, 2007). We tested this assumption with linear regression analysis in which gender, age, and quadratic age were entered as predictors, and the sensation-seeking score as the outcome variable. Only gender had significant standardized regression coefficient ($\beta=-.14$, $p<.001$); age ($\beta=.91$, $p<.09$) and quadratic age ($\beta=-.89$, $p<.10$) had nonsignificant standardized regression coefficients.

Standard errors were calculated with 500 bootstrap samples to determine the significance of the proposed indirect effect and the bias-corrected percentile confidence intervals at 99%. Although the significance tests are informative about which mediation effect is different from zero, the magnitude of mediation is estimated with proportion of mediated effect in the total effect. This procedure provides a stable estimation of effect size of mediation only when the sample size is more than 500 (MacKinnon, Warsi, & Dwyer, 1995).

The final path model with the significant coefficients is presented in Fig. 2. The confidence intervals and significance level of direct and indirect effects are presented in Table 2. The model fit is excellent in a conventional measure ($\chi^2=1.90$ $df=2$ $p=.39$, $N=707$) and the fit is also excellent in terms of less conventional indices (GFI: .999, NFI: .998, CFI: 1.00, RMSEA: .000 [.000–.071]). When we applied the logarithmic transformation of alcohol use score in the path analysis, the model fit was not different ($\chi^2=1.90$ $df=2$ $p=.39$, $N=707$).

Our result supports the hypothesis that the indirect effect is significant between sensation seeking and alcohol use, 35% of the association is explained by the sensation seeking → positive expectancy → drinking motives → alcohol use path. The sensation seeking → positive expectancy → drinking motives mediation explains 47% of the total effect between sensation seeking and drinking motives. Therefore, higher sensation seeking is associated with higher positive expectancy, which is also associated with higher drinking motives score which is linked to higher degree of alcohol consumption. There is another possible path via negative expectancy (sensation seeking → negative expectancy → alcohol use) which explains only 3% of total effects. This path is related to the notion that higher sensation seeking is associated with lower negative expectancy, and lower negative expectancy might lead to higher alcohol use.

We also examined the mediation between age and alcohol use. The indirect effect is significant, and explains 21% of the proportion of total effect. Therefore, higher age is associated with higher positive and lower negative expectancy and higher drinking motives, which significantly explain why alcohol use is higher in older adolescents.

Although the direct effect between gender and alcohol use is significant, we did not found statistically significant indirect effects between gender and alcohol use.

4. Discussion

4.1. Summary of findings and implications

The primary goal of this study was to provide evidence on the mediating role of outcome expectancies and drinking motives in the association between sensation seeking and alcohol use. We extended the previous research with the inclusion of antecedent variables not used previously (age and gender) and two mediators, that is negative expectancy and drinking motives. Earlier

studies focused mainly on positive expectancies and neglected negative expectancies (Darkes et al., 2004; Finn et al., 2000). However, our study shows that negative expectancy has a minor but significant role in mediation of the examined association. Sensation seeking is regarded as a trait characterized by both the tendency of experience seeking and taking risks for such an experience (Zuckerman, 1994). Sensation seeking is associated with the overestimation of positive outcomes of behavior, since higher sensation seeking is associated with higher positive expectancy. The zero-order effect size of the association is medium, and positive expectancy partially but significantly mediates the associations between sensation seeking and drinking motives and sensation seeking and alcohol use.

Sensation-seeking adolescents underestimate the negative consequences of alcohol use. The weak but significant association between sensation seeking and negative expectancy is in accordance with the theory emphasizing that these adolescents have lower capacities to evaluate and use information about potential negative consequences and risks (Millstein & Halpern-Felsher, 2002). The association between negative outcome expectancy and alcohol use is rather weak, although it is important to note that positive expectancy and negative expectancy positively correlate which does not support the heuristic that exciting and favorable behaviors, such as alcohol drinking tend to be seen as less risky (Slovic, Finucane, Peters, & MacGregor, 2002). However, our result is in accordance with the theory of risk as feeling (Loewenstein, Weber, Hsee, & Welch, 2001), suggesting that if a certain risk behavior is associated with positive feelings, the knowledge about the possible negative consequences does not direct the behavior. It is important to note that adolescents who have positive expectancies about the social disinhibition effects of alcohol most probably results in problematic drinking by the age of 30 only if they experience distress as adults. This finding highlights that some moderators may influence the relationship between expectancies and alcohol use (Cable & Sacker, 2007).

This study reveals that positive expectancy has a stronger association with alcohol use than does negative expectancy. This result is also in accordance with earlier studies demonstrating that positive expectancy has a greater influence on alcohol use than negative expectancy (Goldman, Brown, Christiansen, & Smith, 1991; Stacy, Widaman, & Marlatt, 1990).

Our result therefore supports the hypothesis that positive expectancy is an important mediating factor between sensation seeking and alcohol use. Our results fit well with other recent investigations that have focused on high-risk adolescents. Greenbaum, Brown, and Friedman (1995), for instance found that positive social expectancies explain 30% of the association between conduct disorders and alcohol use. More recently, it has been demonstrated that alcohol-related expectancies and peer substance use mediate the association between impulsivity and alcohol consumption (Barnow et al., 2004), and positive alcohol outcome expectancies partially mediate the relationship between childhood delinquency and alcohol consumption (Meier, Slutske, Arndt, & Cadoret, 2007). This study differs from the high-risk studies, since the participants in the present research are typical adolescents with no sign of conduct disorders or delinquency. However, high sensation seeking can be regarded as a risk factor not only for alcohol use but other substance use even without any behavioral or conduct problems.

Age is also an important antecedent factor, since age positively correlates with alcohol use, and it is also expected to be curvilinearly associated with higher sensation seeking. Our sample spans a wide range of age groups from 13 to 20. Although it was not the goal of this research, we tested the recent proposal that during the adolescent period there is a peak in sensation seeking, at age 16.0 for girls and 18.5 for boys in a US sample (Romer & Hennessy, 2007). However, we could not support this finding in our Hungarian sample. Nevertheless, age is associated with increasing alcohol use, and positive and negative expectancy and drinking motives. These associations explain the significant proportion in the association between age and alcohol use. The complex web of indirect effects identifies that increasing age is linked to higher positive expectancy and lower negative expectancy independently from sensation seeking. Older age and more experience with alcohol activates positive expectancies in memory more easily during and even before adolescence (Dunn & Goldman, 1998, 2000). It seems plausible that sensation seeking may increase the activation of positive expectancy in the memory of young adolescents, and this activation contributes to the higher alcohol use. However, it is also possible that sensation seeking fuels the experimentation with alcohol at an early age, and this leads to the implementation and activation of positive expectancies. Further research is needed to support the notion that sensation seeking may influence the activation of positive expectancies in the stage of early adolescence. Although we defined age as an antecedent variable, it could be treated as a moderator variable. The association between expectancies and alcohol use may be different in different age groups. Among younger adolescents, the association between positive expectancy and alcohol use was stronger than in older age groups (Leigh & Stacy, 2004).

We also tested whether drinking motives mediate the association between expectancies and alcohol use and found that they mediate partially the link between positive expectancy and alcohol use. Kuntsche et al. (2007) found full mediation effects of drinking motives, but our model contains both significant direct and mediated effects. In the present analysis, we used the main component of four drinking motives, so we measured mainly the common variance among drinking motives in the path model. Our research is also in accordance with another study which reported that drinking motives mediate only the impact of positive expectancy on alcohol use, and do not mediate the effect of negative expectancy (Engels, Wiers, Lemmers, & Overbeek, 2005).

Although we cannot infer causality, this model describes the possible mechanism that sensation seeking increases positive expectancies, higher positive expectancy also augments the drinking motives which foster alcohol use. Therefore, our research supports the notion that expectancies are more distal and motives are more proximal determinants of alcohol use (Kuntsche et al., 2007). On the other hand, several direct paths are also significant from sensation seeking, positive expectancy, drinking motives, age, and gender to alcohol use. Although the mediation is not perfect, it explains a significant part of the association between sensation seeking and alcohol use. Other mediators could explain the remaining associations. We did not include variables related to alcohol use of peers or preference of deviant peers which might explain the large variance in legal and illegal drug use among adolescents (Barnow et al., 2004; Romer & Hennessy, 2007; Yanovitzky, 2005). Nevertheless, this model helps in understanding why high sensation-seeking adolescents consume more alcohol than their less sensation-seeking peers.

4.2. Conclusions and intervention implications

According to our results, high sensation-seeking adolescents should be targeted by alcohol prevention programs which place an especially strong emphasis on preventing the development of positive expectancy and drinking motives. Since positive expectancy is a more important mediator than negative expectancy, programs should be developed which change the positive image of alcohol use among adolescents with high sensation seeking. Prevention programs should place even more emphasis on challenging the positive expectancies that are related to alcohol use. As well as strategies to decrease the appeal of alcohol use among young people, the promotion of attractive and alternative activities which are incompatible with alcohol use and, at the same time, fulfill the needs of sensation seekers, would be a further choice of intervention strategy for sensation-seeking adolescents. Another option for prevention is to delay the experimentation with alcohol in high sensation seekers by restricting the availability of alcohol in those settings visited by sensation-seeking adolescents most frequently.

Some studies identify the effectiveness of programs targeting personality risk factors of alcohol use, such as sensation seeking, anxiety, and hopelessness (Conrod, Stewart, Comeau, & Maclean, 2006). Brief, personalized prevention work targeting risk-taking behaviors may also be effective in adolescent populations (e.g. D'Amico & Fromme, 2002); however, further research is needed to analyze whether these programs are also efficient among high sensation-seeking teenagers. Public health communication campaigns targeting high sensation-seeking adolescents has successfully reversed upward developmental trends in marijuana use among high sensation-seeking adolescents, and significantly reduced positive marijuana attitudes and beliefs among them (Palmgreen, Lorch, Stephenson, Hoyle, & Donohew, 2007).

4.3. Limitations and directions for future research

The results of the present study should be regarded with caution since the causal relationship is uncertain due to the cross-sectional design. This study cannot explain whether the positive expectancy and higher drinking motives are either antecedents or consequences of alcohol use. If sensation seeking is considered to be a relatively stable personality trait, then we can outline two possible mechanisms. One possibility would imply that sensation seeking increases the experimentation with alcohol, which consequently strengthens or weakens the positive and negative expectancies and also increases drinking motives. According to the other possibility, sensation seeking generates stronger positive expectancies. Positive expectancy further increases drinking motives which make the frequency of alcohol use and intensity higher. At any rate, we think it is important that research should focus on the underlying, mediating constructs in order to explain the association. We cannot exclude completely the possibility that sensation seeking changes over time, and peaks during adolescence; moreover, it may be plausible that both sensation seeking and positive expectancy develop continuously owing to the continuous increasing disinhibition and experimentation with alcohol during adolescence development.

This study cannot address the issue of whether sensation seeking generally increases positive expectancies towards the use of psychoactive substances and other risk behavior, or if this effect is confined to alcohol use only.

A further question still remaining is what factors make higher sensation-seeking adolescents vulnerable to believe more strongly in positive outcomes of alcohol consumption than their less sensation-seeking peers. One possibility is that sensation seekers use information about the consequences of alcohol use selectively and are biased toward the positive messages from the media and from interactions with peers and adults. The other possibility is that they are more sensitive to the effects of alcohol; therefore, the early experimentation has a greater impact on the development of their expectancies. Understanding the development of positive expectancies in high sensation-seeking adolescents could help to design tailored prevention programs in order to allow these adolescents to benefit from their wonderful curiosity for various experiences, and help them to avoid its harmful impacts in relation to drug and alcohol use.

References

Andersen, A., Due, P., Holstein, B. E., & Iversen, L. (2003). Tracking drinking behaviour from age 15–19 years. *Addiction*, *98*(11), 1505–1511.

Aszmann, A. (2003). *Health behaviour in school-aged children: A WHO Cross-national Study. National Report, Hungary.* Budapest: National Institute of Child Health.

Babocsay, Á. (2002). Relationship between sensation seeking and mass media usage. Unpublished doctoral dissertation. Eötvös Loránd University, Hungary.

Barnow, S., Schultz, G., Lucht, M., Ulrich, I., Preuss, U. W., & Freyberger, H. J. (2004). Do alcohol expectancies and peer delinquency/substance use mediate the relationship between impulsivity and drinking behaviour in adolescence? *Alcohol and Alcoholism*, *39*(3), 213–219.

Cable, N., & Sacker, A. (2007). The role of adolescent social disinhibition expectancies in moderating the relationship between psychological distress and alcohol use and misuse. *Addictive Behaviors*, *32*(2), 282–295.

Conrod, P. J., Stewart, S. H., Comeau, N., & Maclean, A. M. (2006). Efficacy of cognitive-behavioral interventions targeting personality risk factors for youth alcohol misuse. *Journal of Clinical Child & Adolescent Psychology*, *35*(4), 550–563.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*(2), 117–128.

Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology*, *97*(2), 168–180.

D'Amico, E. J., & Fromme, K. (2002). Brief prevention for adolescent risk-taking behavior. *Addiction*, *97*(5), 563–574.

Darkes, J., Greenbaum, P. E., & Goldman, M. S. (2004). Alcohol expectancy mediation of biopsychosocial risk: Complex patterns of mediation. *Experimental & Clinical Psychopharmacology*, *12*(1), 27–38.

Demetrovics, Zs. (2007). *Drog, család, személyiség [Drugs, family and personality].* Budapest: L'Harmattan.

Dunn, M. E., & Goldman, M. S. (1998). Age and drinking-related differences in the memory organization of alcohol expectancies in 3rd-, 6th-, 9th-, and 12th-grade children. *Journal of Consulting & Clinical Psychology*, *66*(3), 579–585.

Dunn, M. E., & Goldman, M. S. (2000). Validation of multidimensional scaling-based modeling of alcohol expectancies in memory: Age and drinking-related differences in expectancies of children assessed as first associates. *Alcoholism, Clinical and Experimental Research*, *24*(11), 1639–1646.

Engels, R. C., Wiers, R., Lemmers, L., & Overbeek, G. J. (2005). Drinking motives, alcohol expectancies, self-efficacy, and drinking patterns. *Journal of Drug Education*, *35*(2), 147–166.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., Strahan, E. J., & Becker, G. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*(3), 272–299.
Finn, P. R., Sharkansky, E. J., Brandt, K. M., & Turcotte, N. (2000). The effects of familial risk, personality, and expectancies on alcohol use and abuse. *Journal of Abnormal Psychology*, *109*(1), 122–133.
Goldman, M. S., Brown, S. A., Christiansen, B. A., & Smith, G. T. (1991). Alcoholism and memory: Broadening the scope of alcohol-expectancy research. *Psychological Bulletin*, *110*(1), 137–146.
Greenbaum, P. E., Brown, E. C., & Friedman, R. M. (1995). Alcohol expectancies among adolescents with conduct disorder: Prediction and mediation of drinking. *Addictive Behaviors*, *20*(3), 321–333.
Health for All Database (HFA-DB) (2007). *Copenhagen, WHO Regional Office for Europe*. Retrieved on April 30, 2008 from http://www.euro.who.int/hfadb Last update is November 2007.
Henderson, M. J., Goldman, M. S., Coovert, M. D., & Carnevalla, N. (1994). Covariance structure models of expectancy. *Journal of Studies on Alcohol*, *55*(3), 315–326.
Hibbel, B., Andersson, B., Bjarnasson, T., Ahlström, S., Balakireva, O., Kokkevi, A., et al. (2004). The ESPAD Report 2003. Alcohol and other drug use among students in 35 European countries. Stockholm: The Swedish Council for Information on Alcohol and Other Drugs (CAN) & Council of Europe, Co-operation Group to Combat Drug Abuse and Illicit Trafficking in Drugs (Pompidou Group).
Hittner, J. B., & Swickert, R. (2006). Sensation seeking and alcohol use: A meta-analytic review. *Addictive Behaviors*, *31*(8), 1383–1401.
Katz, E. C., Fromme, K., & D'Amico, E. J. (2000). Effects of outcome expectancies and personality on young adults' illicit drug use, heavy drinking, and risky sexual behavior. *Cognitive Therapy and Research*, *24*(1), 1–22.
Kuntsche, E., Knibbe, R., Engels, R., & Gmel, G. (2007). Drinking motives as mediators of the link between alcohol expectancies and alcohol use among adolescents. *Journal of Studies on Alcohol & Drugs*, *68*(1), 76–85.
Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review*, *25*(7), 841–861.
Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2006). Replication and validation of the Drinking Motive Questionnaire Revised (DMQ-R, Cooper, 1994) among adolescents in Switzerland. *European Addiction Research*, *12*(3), 161–168.
Leigh, B. C. (1989). In search of the Seven Dwarves: Issues of measurement and meaning in alcohol expectancy research. *Psychological Bulletin*, *105*(3), 361–373.
Leigh, B. C., & Stacy, A. W. (1993). Alcohol outcome expectancies: Scale construction and predictive utility in higher order confirmatory models. *Psychological Assessment*, *5*(2), 216–229.
Leigh, B. C., & Stacy, A. W. (2004). Alcohol expectancies and drinking in different age groups. *Addiction*, *99*(2), 215–227.
Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, *127*(2), 267–286.
MacKinnon, D. P., Warsi, G., & Dwyer, J. H. (1995). A simulation study of mediated effect measures. *Multivariate Behavioral Research*, *30*(1), 41–62.
Magid, V., Maclean, M. G., & Colder, C. R. (2007). Differentiating between sensation seeking and impulsivity through their mediated relations with alcohol use and problems. *Addictive Behaviors*, *32*(10), 2046–2061.
Martino, S. C., Collins, R. L., Ellickson, P. L., Schell, T. L., & McCaffrey, D. (2006). Socio-environmental influences on adolescents' alcohol outcome expectancies: A prospective analysis. *Addiction*, *101*(7), 971–983.
McCarthy, D. M., Kroll, L. S., & Smith, G. T. (2001). Integrating disinhibition and learning risk for alcohol use. *Experimental & Clinical Psychopharmacology*, *9*(4), 389–398.
Meier, M. H., Slutske, W. S., Arndt, S., & Cadoret, R. J. (2007). Positive alcohol expectancies partially mediate the relation between delinquent behavior and alcohol use: Generalizability across age, sex, and race in a cohort of 85,000 Iowa schoolchildren. *Psychology of Addictive Behaviors*, *21*(1), 25–34.
Miller, P. M., Smith, G. T., & Goldman, M. S. (1990). Emergence of alcohol expectancies in childhood: A possible critical period. *Journal of Studies on Alcohol*, *51*(4), 343–349.
Millstein, S. G., & Halpern-Felsher, B. L. (2002). Perceptions of risk and vulnerability. *Journal of Adolescent Health*, *31*(1 Suppl), 10–27.
Ministry of Education and Culture (2006). *Statistical yearbook of education 2005/2006.* Budapest: Ministry of Education and Culture.
Nagy, J., & Kulcsár, Zs. (1998). Personality factors differentiating juvenile delinquents from other groups. In J. Bermúdez, B. De Raad, J. De Vries, A. M. Perez-Garcia, A. Sanchez-Elvira, & G. L. Van Heck (Eds.), *Personality psychology in Europe, vol. 6*. (pp. 286–294)Tilburg: Tilburg University Press.
Newburn, T., & Shiner, M. (2001). *Teenage kicks? Young people and alcohol: A review of the literature.* York: Joseph Rowntree Foundation.
Oei, T. P., & Morawska, A. (2004). A cognitive model of binge drinking: The influence of alcohol expectancies and drinking refusal self-efficacy. *Addictive Behaviors*, *29*(1), 159–179.
Palmgreen, P., Lorch, E. P., Stephenson, M. T., Hoyle, R. H., & Donohew, L. (2007). Effects of the Office of National Drug Control Policy's Marijuana Initiative Campaign on high-sensation-seeking adolescents. *American Journal of Public Health*, *97*(9), 1644–1649.
Rather, B. C., Goldman, M. S., & Roehrich, L. (1992). Empirical modeling of an alcohol expectancy memory network using multidimensional scaling. *Journal of Abnormal Psychology*, *101*(1), 174–183.
Roberti, J. W. (2004). A review of behavioral and biological correlates of sensation seeking. *Journal of Research in Personality*, *38*(3), 256–279.
Romer, D., & Hennessy, M. (2007). A biosocial-affect model of adolescent sensation seeking: The role of affect evaluation and peer-group influence in adolescent drug use. *Prevention Science*, *8*(2), 89–101.
Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). Rational actors or rational fools? Implications of the affect heuristic for behavioral economics. *Journal of Socio-Economics*, *31*, 329–342.
Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, *106*(1), 61–73.
Stacy, A. W., Widaman, K. F., & Marlatt, G. A. (1990). Expectancy models of alcohol use. *Journal of Personality and Social Psychology*, *58*(5), 918–928.
Staiger, P. K., Kambouropoulos, N., & Dawe, S. (2007). Should personality traits be considered when refining substance misuse treatment programs? *Drug and Alcohol Review*, *26*(1), 17–23.
Wiers, R. W., van Woerden, N., Smulders, F. T. Y., & de Jong, P. J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology*, *111*(4), 648–658.
Yanovitzky, I. (2005). Sensation seeking and adolescent drug use: The mediating role of association with deviant peers and pro-drug discussions. *Health Communication*, *17*(1), 67–89.
Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking.* Cambridge: Cambridge University Press.