

Original Investigation

# Smoking outcome expectancies mediate the association between sensation seeking, peer smoking, and smoking among young adolescents

Róbert Urbán

## Abstract

**Background:** Sensation seeking is a strong correlate of smoking among adolescents, yet the research on mediators of this association is not well established. The proposed model of the present study includes antecedent variables (sensation seeking), mediators (perceived peer smoking, outcome expectancies including negative consequences, positive reinforcement, negative reinforcement, and appetite-and-weight control), and one outcome variable (smoking cigarettes during the past 30 days).

**Methods:** Self-reported data obtained from Hungarian high-school students (ninth grade,  $N = 2,565$ , mean age 15.3 years,  $SD = 0.56$ ) were analyzed with structural equation modeling. Before testing of the main model, the construct validity of mediators (outcome expectancy scales) was supported with confirmatory factor analysis (CFA) and structural equation modeling. The final model was tested with structural equation modeling, and the goodness-of-fit indices and the proportion of direct and indirect effects were analyzed.

**Results:** Our mediational model had an excellent model fit, and this study supported both the proposed sensation seeking→positive and negative reinforcement→smoking behavior pathways and sensation seeking→perceived peer smoking→positive and negative reinforcement→smoking behavior pathways. The total indirect effect explains 76% of sensation seeking and smoking association. Results support the notion that positive and negative reinforcement expectancies mediate between sensation seeking and smoking.

**Discussion:** Results support the notion that perceived peer smoking, positive and negative reinforcement expectancies mediate between sensation seeking and smoking.

## 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). This research report aims to develop an explanatory model based on expectancy theories of smoking behaviors for the association between sensation seeking and smoking among Hungarian adolescents.

As the country with the highest rates of lung cancer and cardiovascular mortality in Europe, Hungary demonstrates the detrimental impact of smoking (Brennan & Bray, 2002). In order to tackle these negative statistics in the long term, studies on adolescent smoking are of crucial importance. Experimentation with smoking and development of nicotine addiction during adolescence represent a major public health concern. According to the Health Behavior in School-Aged Children survey, 67.0% of ninth-grade boys and 69.5% of ninth-grade girls in Hungary have already tried tobacco and 26.5% of ninth-grade adolescents smoke cigarettes at least once a week (Németh, 2007).

Research on smoking among adolescents should focus on distal and proximal variables that might explain the smoking behavior in order to construct effective programs to influence nicotine use among teenagers. The recent motivational models of drug use propose that outcome expectancies mediate between antecedents like personality and drug-use behavior, including alcohol use (Williams & Clark, 1998), marijuana use (Vangsness, Bry, & LaBouvie, 2004), and cocaine use (Stacy, Newcomb, & Bentler, 1995). In other words, these models imply that expectancies might be a final common pathway to drug use through which personality traits exert their influences. Following the suggestions of Baron and Kenny (1986), in order to test the mediational properties of outcome expectancies between sensation

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## Sensation seeking and expectancies

seeking and smoking, we need to present compelling evidence that first, sensation seeking predicts smoking; second, smoking outcome expectancies predict smoking; third, sensation seeking predicts smoking outcome expectancies; and finally, that the mediation can explain a significant part of the association between sensation seeking and smoking behaviors.

The association between sensation seeking and smoking has been reliably reported (Carton, Jouvent, & Widlocher, 1994; Dinn, Ayciceggis, & Harris, 2004; Frankenberger, 2004; Kopstein, Crum, Celentano, & Martin, 2001; Roberti, 2004; Stephenson, Hoyle, Palmgreen, & Slater, 2003; Zuckerman, 2007; Zuckerman, Ball, & Black, 1990). For example, Stephenson et al. demonstrated a medium-size correlation between sensation seeking and smoking variables including ever-smoking, 30-day smoking, and favorable attitude toward smoking in a large community sample of teenagers from Grades 7 to 11. A few studies have highlighted some possible mechanisms that may explain the association between sensation seeking and smoking. An experimental study demonstrated that higher levels of sensation seeking are associated with higher initial sensitivity to nicotine (Perkins, Gerlach, Broge, Grobe, & Wilson, 2000), which in turn might also reflect indirectly the individual differences in reinforcement properties of nicotine. Another study focused on the role of peers in adolescent substance use and presented evidence that the affiliation with substance-using peers can mediate the association between novelty seeking and substance use including smoking (Wills, Windle, & Cleary, 1998). Therefore, this study suggests that novelty seeking has a direct effect on more deviant peer affiliations, likely reflecting a tendency to seek out peers who share an inclination for arousing and exciting experiences. Despite the previous research, understanding why sensation seeking and smoking are associated requires further investigations. In the present study, smoking-related outcome expectancies are proposed as mediators between sensation seeking and smoking. In the case of other drug use, such as alcohol, several studies (eg. Urbán, Kökönyei, & Demetrovics, 2008; Darkes, Greenbaum, & Goldman, 2004) have demonstrated that alcohol-related expectancies mediate partially but significantly the association between sensation seeking and alcohol use.

Several studies have demonstrated that smoking outcome expectancies predict smoking-related behaviors in both adults (Brandon & Baker, 1991; Copeland, Brandon, & Quinn, 1995) and adolescents (Anderson, Pollak, & Wetter, 2002; Hine, Honan, Marks, & Brettschneider, 2007; Lewis-Esquerre, Rodrigue, & Kahler, 2005; Wahl, Turner, Mermelstein, & Flay, 2005); however, there is a debate when it comes to identifying the number and content of outcome expectancy factors. Smoking outcome expectancies can be defined as beliefs about the possible effects associated with smoking on behavior, cognition, moods, and emotions. Although the development of these expectancies is not well understood, parental behavior, interaction with peers, and media representation of smoking might direct and reinforce the formation of smoking outcome expectancies and further experimentation with smoking might also reinforce certain expectancies. In the present research, we focus on four types of outcome expectancies (Brandon & Baker; Myers, McCarthy, MacPherson, & Brown, 2003), namely, negative consequences, positive reinforcement, negative reinforcement, and appetite and weight control expectancies. Negative consequences refer to the

expectancies related to long-term negative health consequences of smoking. Positive/sensory reinforcement expectancies refer to expectancies of individual sensory satisfaction from smoking. Negative reinforcement denotes expectancies regarding coping and negative emotion regulation through smoking. Finally, appetite and weight control represents expectancies that smoking helps to manage appetite and weight.

The association between sensation seeking-related personality traits and smoking outcome expectancies is studied only sporadically. Some research focused on the association between impulsivity and smoking-related positive and negative reinforcement expectancies. Doran, McChargue, and Cohen (2007) presented evidence that heightened impulsivity is associated with greater expectations regarding the positive and negative reinforcements from cigarette smoking in college student smokers. Another study also showed that higher levels of impulsivity were related to increases in positive reinforcement expectancies during a period of abstinence (VanderVeen, Cohen, Trotter, & Collins, 2008).

In the present study, we propose that high sensation seekers expect more positive reinforcement. Higher sensation seeking is related to the stronger positive affective expectancy from drug use; moreover, this expectancy also mediates between sensation seeking and tobacco use among adolescents (Romer & Hennessy, 2007). Since the positive reinforcement expectancies scale is mainly focused on taste and sensory stimulation, our prediction is in accordance with the observation that sensation seeking is associated with stronger preference of unusual and intense taste and sensory stimulation (Terasaki & Imada, 1988, Zuckerman, 1994, 2007). Even a simple experimental manipulation about a new cigarette flavor increased the intention to try a new brand among high (but not low) sensation seeker adolescents (Manning, Kelly & Comello, 2009).

Based on earlier research on impulsivity and smoking reinforcement expectancies (Doran et al., 2007) and research on nicotine sensitivity (Perkins et al., 2000), we also propose that sensation seeking predicts higher negative reinforcement expectancies related to cigarette consumption; and higher negative reinforcement expectancies, in turn, lead to more experimentation with smoking.

In the present study, we also introduce perceived peer smoking as a mediator between sensation seeking and smoking and also sensation seeking and smoking-related outcome expectancies for at least two reasons. On the one hand, sensation seeking is associated with drug use, including alcohol and marijuana use and smoking, both directly and indirectly through peers, (Donohew, Clayton, Skinner, & Colon, 1999; Romer & Hennessy, 2007, Wills et al., 1998). On the other hand, Hine, McKenzie-Richer, Lewko, Tilleczek, and Perreault (2002) described how the effects of peer and current smoking on future smoking are mediated by adolescents' expectancies about negative affect control, whereas the relationship between current smoking and future smoking is also mediated by adolescents' beliefs about the desirability of weight control. In another study, Romer and Hennessy have also demonstrated that perceived peer use and peer approval combined into one latent variable called peer attraction are associated with positive affective expectancy; moreover, this expectancy also mediates between peer attraction and smoking.

## Purpose of the present study

Our work is based on earlier work exploring smoking outcome expectancies among high-school students. Instead of attempting to define a number of expectancy factors, we established our work on four core expectancies defined by Brandon and Baker (1991) and Myers et al. (2003). Our goals were twofold: (a) to examine the validity of the Hungarian version of the short form of the Smoking Consequences Questionnaire with estimation of the measurement model and the concurrent criterion validity of each subscale and (b) to examine our hypotheses regarding mediational properties of outcome expectancies between distal variables such as sensation seeking and perceived peer smoking and smoking. The first goal is a prerequisite for the accomplishment of the second goal.

We propose several paths between sensation seeking and smoking. The first paths describe that sensation seeking increases both positive and negative reinforcement expectancies, and higher reinforcement expectancies, in turn, enhance smoking. The other path describes the association between sensation seeking and perceived peer smoking; therefore, sensation seeking might boost the salience of peer smoking, which in turn increases the smoking. In the final, and most complex, path, we propose that sensation seeking increases the perceived peer smoking, which in turn boosts positive and negative reinforcement expectancies, and finally, these expectancies are the final path to smoking. In this final path, we imply that smoking-related expectancies are conveyed through peer smoking behavior. Besides the proposed paths, we also included two other paths in order to support the discriminant validity of positive and negative reinforcement expectancies compared with the other two types of expectancies; therefore, we added a path from sensation seeking to negative consequences and another one also to appetite and weight control expectancies. We expect higher path coefficients from sensation seeking to positive and negative expectancies than to negative consequences and appetite and weight control expectancies.

## Methods

### Participants and procedure

Altogether, 150 high schools were invited to participate in a longitudinal study on adolescent smoking (Budapest Adolescent Smoking Study) and 70 schools in total replied positively to the request. Schools were selected randomly within each district of the city. Each school was contacted three times. When a school declined or did not respond, we randomly selected another school from the same district. Although the response rate from the schools was relatively low, our sample still represents geographically both general high schools and vocational schools in Budapest. The main reason for refusal was the overload of schools with surveys and research. For each high school, one or two classes were randomly selected. The final sample of the first wave consisted of 106 classes and we targeted 3,124 students. A passive informed consent form was sent to parents; 271 parents refused permission and 288 students were missing during the data collection.

The final sample was composed of 2,565 high-school students (mean age = 15.3 years,  $SD = 0.56$  years; 1,251 boys and 1,314 girls).

The participants were asked to complete the questionnaire in their classrooms within one class session, and therefore the sample characteristics reflect the composition of the participating classes. Subjects were informed both orally and in writing that participation in the study was voluntary. The present study was approved by the Institution Review Board of Eötvös Loránd University.

## Measures

**Smoking.** Self-reported smoking behavior was assessed by the Hungarian version of smoking-related questions from the Youth Risk Behavior Survey 2009 (Centers for Disease Control and Prevention, 2009). In the current analysis, we used two major questions: (a) Have you ever tried a cigarette, even if only a few puffs? (b) Did you smoke at least one cigarette in the past 30 days and if so, how many? These questions made it possible to categorize the respondents into four groups: never tried, experimenter (tried it but did not smoke during the past 30 days), intermittent smokers (did not smoke every day during the past 30 days), and regular or established smokers (smoked every day during the past 30 days; see this categorization in Lloyd-Richardson, Papandonatos, Kazura, Stanton, & Niaura, 2002). In the present analysis, smoking status was dichotomized into nonsmokers who did not smoke during the past 30 days (nonsmokers and experimenters combined and coded 0) and smokers who smoked during the past 30 days (intermittent regular smokers combined and coded 1).

**Nicotine dependence.** Nicotine dependence was measured using the Hooked on Nicotine Checklist (DiFranza et al., 2002), which contains 10 items asking about the symptoms of diminished autonomy and smoking. We applied this measure with continuous scoring, and therefore the response options were never, rarely, sometimes, and very often. This scale was applied only when participants reported smoking in the past 30 days. Internal consistency of the scale in the present sample is excellent (Cronbach  $\alpha = .93$ ).

**Smoking outcome expectancies.** The 21-item short form of the Smoking Consequences Questionnaire (Myers et al., 2003) was used to measure smoking outcome expectancies. The items in the original version of the Smoking Consequences Questionnaire were published by Myers et al., and the Hungarian version of the Smoking Consequences Questionnaire is available from the author of the present report. The questionnaire was translated as well as back-translated and inconsistencies were resolved. We included only the likelihood rating form, as suggested by Myers et al., since the likelihood scores discriminate best between different levels of smoking. The Hungarian version of the Smoking Consequences Questionnaire was tested on an independent sample of adolescents, and the psychometric properties of the scale were found to be satisfactory including internal consistencies and CFA (Urbán & Demetrovics, 2009).

**Sensation seeking.** Sensation seeking was assessed with an eight-item version of a sensation-seeking scale (Brief Sensation-Seeking Scale, BSSS) yielding one sensation-seeking score (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002). Internal consistency of the original BSSS was 0.76 (Hoyle et al.) and that of the Hungarian BSSS was 0.71. The structure of the Hungarian BSSS was supported with a CFA in the present sample (comparative fit

index [CFI]: 0.96; Tucker-Lewis index [TLI]: 0.90; root mean square error approximation [RMSEA]: 0.060 [0.040–0.072]).

**Perceived peer smoking.** Perceived peer smoking was measured with one item asking about perceived prevalence of smoking and two items about friends, smoking. The perceived prevalence of smoking item was measured by a question asking how many youths of a similar age and gender smoked out of 100. Students responded on an 11-point scale, from zero to 100, in 10-point increments. We measured the friends smoking item with two questions: How many of your five closest friends have ever tried smoking (0–5), and how many of your five closest friends smoke at least one cigarette a week (0–5)? Principal component analysis on these items revealed only one component, which explained 64% of variance, and therefore we concluded that these items could form one latent variable called perceived peer smoking in the structural equation analysis.

### Statistical analyses

In the first step in our analysis, CFA was used to assess the factor structure and item performance of the Hungarian short version of the smoking consequences questionnaire. Analysis was performed with the MPLUS 5.2 program. Because our sample is a complex sample, we performed CFA with maximum likelihood parameter estimates with standard errors and chi-square test statistics that were robust to nonnormality and nonindependence of observation (Muthén & Muthén, 1998–2007, p. 484).

In the second step, we tested the concurrent validity of the scales with two variables, namely, current smoking status and level of nicotine addiction. In the *SEM* analysis, two models were estimated. The first model, in which outcome expectancies predicted current smoking status, was tested on the whole sample, and the second model, which involved nicotine addiction, was tested only on the smokers' subsample.

In the third step, we tested the mediation properties of outcome expectancies between sensation seeking, perceived peer smoking, and smoking. The magnitude of mediation was estimated from the proportion of mediated effect in the total effect. This procedure provides a stable estimation of the effect size of mediation only when the sample size is more than 500 (MacKinnon, Warsi, & Dwyer, 1995).

In the second and third steps, weighted least square parameter estimates (using a diagonal weight matrix with standard errors and mean-adjusted chi-square test statistics that used a full weight matrix) were applied to estimate the models. According to Muthén and Muthén (1998–2007), this estimation is applicable when the model contains a binary dependent variable. We also used complex sample modeling. This approach “computes standard errors and a chi-square test of model fit taking into account stratification, non-independence of observations, and/or unequal probability of selection” (Muthén & Muthén, p. 477).

A satisfactory degree of fit requires the CFI to be larger than 0.95 and the nonnormed fit index (or TLI) to be larger than 0.95: The third fit index applied in these models was RMSEA. RMSEA below 0.05 indicates excellent fit, a value around 0.08 indicates adequate fit, and a value above 0.10 indicates poor fit. In the first step of our analysis, we also added the standardized root mean square residual (SRMR). An SRMR value below 0.08 is considered a good fit.

## Results

### Smoking behavior

The prevalence of lifetime smoking is 62.3% in our sample, which is consistent with the most current population data of Hungarian adolescents from similar age group (Demjén et al., 2009; Hibell et al., 2009; Németh, 2007) According to our coding schema, 37.7% of participants ( $N = 966$ ) had not tried cigarettes, 31.1% of participants ( $N = 798$ ) were experimenters, 19.7% of participants ( $N = 506$ ) were intermittent smokers, and finally 11.5% of participants ( $N = 295$ ) were regular daily smokers. Significant gender differences have been found in smoking status ( $\chi^2 = 26.7$ ,  $df = 3$ ,  $p < .001$ ). Higher prevalence of intermittent smoking and regular daily smoking was detected in girls (23.3% and 12.0%, respectively) than in boys (15.9% and 11.0%, respectively), while nonsmoking and experimenting were more prevalent in boys (41.2% and 31.9%, respectively) than in girls (34.4% and 30.3%, respectively). Similarly, higher prevalence of smoking in girls is detected in the majority (60%) of countries involved in the European School Survey Project on Alcohol and Other Drugs including Hungary (Hibell et al.), and this difference is also presented in the most recent National Report of Global Youth Tobacco Survey (Demjén et al.).

### Confirmatory factor analysis

Although CFA analysis resulted in a significant chi-square value  $\chi^2 = 1,417$ ,  $df = 183$ ,  $p < .0001$ , all of the other fit indices showed adequate fit: CFI: 0.954, TLI: 0.947, RMSEA: 0.051 (0.049–0.054), and SRMR: 0.033. Inspection of the modification indices has revealed, however, that freeing the covariance between errors of two items would increase the degree of fit. These items (“When I’m angry a cigarette can calm me down” and “Smoking calms me down when I feel nervous”) are strongly related in content, emphasizing the calming effect of smoking. After we freed the covariance, the fit indices indicated significantly better fit:  $\chi^2 = 1,041$ ,  $df = 182$ ,  $p < 0.0001$ ; CFI: 0.968, TLI: 0.963, RMSEA: 0.043 (0.040–0.045), and SRMR: 0.031. In this latter model, all of the items have factor loadings above 0.74, as presented in Table 1. We also performed a multigroup CFA in order to test the fit of the model in both smokers and nonsmokers. The fit indices show adequate fit  $\chi^2_{\text{nonsmokers}}(398) = 943$ ;  $\chi^2_{\text{smokers}}(398) = 527$ ; CFI: 0.954, TLI: 0.952, RMSEA: 0.046 (0.043–0.048), and SRMR: 0.042.

### Concurrent criterion validity of smoking outcome expectancies

We also tested the concurrent validity of scales with multigroup structural equation modeling in which the outcome variable was the smoking status and the grouping variable was gender. The multigroup *SEM* revealed an adequate fit of the model in which factor loadings and regression coefficients were allowed to vary across the two groups  $\chi^2_{\text{boys}}(474) = 687$ ;  $\chi^2_{\text{girls}}(474) = 588$ ; CFI = 0.979, TLI = 0.977, RMSEA = 0.039. The estimated correlation between latent variables and smoking, and standardized regression coefficients predicting smoking status, are presented in Table 2. Negative and positive reinforcement predicts smoking status strongly in both boys and girls and the sizes of standardized regression coefficients are very similar in both groups. There are, however, dissimilarities that deserve attention. On the one hand, negative consequences predict lower probability of smoking in girls only. This result suggests that expectancies of



**Table 1. Short form of Smoking Consequences Questionnaire—Adolescent: Item and scale information**

Scale (coefficient alpha reliability)	Loading
Negative consequences (.90)	
Smoking is taking years off my life	.759
Smoking is hazardous to my health	.884
By smoking I risk heart disease and lung cancer	.892
The more I smoke, the more I risk my health	.872
Positive reinforcement (.94)	
The taste is pleasant when smokers smoke*	.859
I enjoy the taste sensations while smoking	.909
I enjoy feeling a cigarette on my tongue and lips	.837
Cigarettes taste good	.895
I enjoy the flavor of a cigarette	.886
Negative reinforcement (.95)	
When I'm angry a cigarette can calm me down	.869
Cigarettes help me deal with anxiety or worry	.748
Smoking calms me down when I feel nervous	.893
Cigarettes help me reduce or handle tension	.896
Cigarettes help me deal with anger	.887
When I'm upset with someone, a cigarette helps me cope	.902
Smoking helps me deal with depression	.779
Appetite and weight control (.90)	
Smoking keeps my weight down	.790
Cigarettes keep me from overeating	.868
Smoking controls my appetite	.753
Cigarettes keep me from eating more than I should	.825
Smoking helps me control my weight	.821

*Notes.* The original item (When I smoke, the taste is pleasant.) was reworded. Hungarian version of questionnaire is available on request from the author.

negative consequences can be protective in girls but not in boys. On the other hand, appetite and weight control expectancies are negatively but weakly related with smoking in boys and unrelated to smoking in girls. In order to understand these unexpected coefficients, we estimated the binary correlations between appetite and weight control expectancy as a latent variable and smoking in boys and girls separately.

We found that smoking correlated with appetite and weight control expectancies positively in boys and girls as well ( $r_{\text{boys}} = .28$ ,  $r_{\text{girls}} = .31$ ), so we can conclude that the anomalous negative regression coefficient from appetite and weight control to smoking in boys and the lack of association in girls can be regarded as examples of negative suppressor effect (Lancaster, 1999; Tu, Gunnell, & Gilthorpe, 2008).

We performed another analysis of smokers only. In this case, the outcome variable was the nicotine addiction score based on the Hooked on Nicotine Checklist score, which was entered as an observed variable. The model fit was adequate:  $\chi^2(199) = 526$ ; CFI: 0.963, TLI: 0.957, RMSEA: 0.045 (0.041–0.050), and SRMR: 0.035. Standardized regression coefficients are presented in Table 2. Nicotine addiction was significantly predicted by positive and negative reinforcement expectancies in the smokers subgroup.

### Mediation analysis between sensation seeking and smoking

We performed another structural equation analysis in order to investigate the mediational properties of outcome expectancies between sensation seeking, peer smoking, and smoking. We entered all variables as latent variables except smoking. The advantage of structural equation modeling in the present analysis is that specifying all predictors and mediators as latent variables removes any bias related to measurement errors owing to the lack of perfect reliability and therefore all direct and indirect effects can be estimated more precisely.

The final model and path coefficients are depicted in Figure 1, in which the nonsignificant paths are trimmed and the indicator variables for latent variables are omitted for the sake of simplicity and the path coefficient from appetite and weight control to smoking was fixed at zero in order to avoid statistical suppression effects. The fit indices reveal satisfactory fit:  $\chi^2(471) = 3363$ ; CFI = 0.951, TLI = 0.945, RMSEA = 0.049.

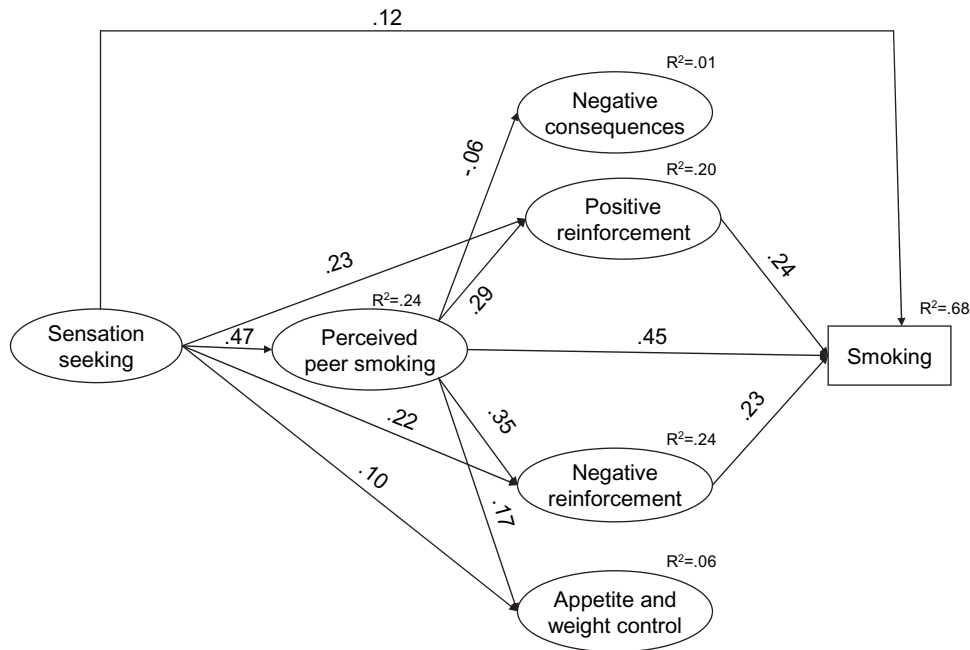
As shown in Figure 1, higher sensation seeking is associated with stronger perceived peer smoking. Stronger perceived peer smoking is also associated with higher positive reinforcement, negative reinforcement, and appetite and weight control. Higher positive and negative reinforcement expectancies are also associated with smoking. Higher sensation seeking is associated with higher probability of smoking directly and also indirectly

**Table 2. Smoking outcome expectancies predict smoking: Standardized regression coefficients**

	Smoking				Nicotine addiction	
	Boys ( $N = 1,251$ )	Girls ( $N = 1,314$ )			Smokers ( $N = 801$ )	
	<i>r</i>	Stand. beta	<i>r</i>	Stand. beta	<i>r</i>	Stand. beta
Negative consequences	.04	−0.07†	−.10	−0.12***	.04	0.05
Positive reinforcement	.61	0.29***	.66	0.35***	.32	0.11**
Negative reinforcement	.64	0.50***	.67	0.46***	.46	0.39***
Appetite and weight control	.28	−0.10*	.31	−0.05	.24	0.05
$R^2$		38%		42%		22%

*Note.* *r* = estimated bivariate correlation between latent variables and smoking or nicotine addiction; stand. beta = standardized regression coefficients.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .



**Figure 1.** Mediation model of sensation seeking, perceived peer smoking, and smoking. All solid standardized path coefficients are significant (at least  $p < .001$ ). Path from appetite and weight control to smoking is fixed to zero.

through the mediating variables. Stronger perceived peer smoking is also associated with smoking both directly and indirectly through the outcome expectancies. Negative consequences were not, however, associated with sensation seeking. Perceived peer smoking is associated only weakly with negative expectancies.

We also estimated how much the association between sensation seeking and smoking can be explained by the mediator variables. Standardized estimates of direct and total indirect effects are presented in Table 3. The total effect between sensation seeking and smoking is 0.51, which shows a relatively strong association between sensation seeking and smoking. According to our estimation, however, 76% of the association between sensation seeking and smoking is explained by peer smoking and positive reinforcement and negative reinforcement expectancies.

**Table 3. Standardized estimates of direct and total indirect effects on smoking and mediator variables**

	Effect	SE	% explained of total effect
SSS → smoking (total effect)	0.51	0.024	
SSS → smoking (total indirect effect)	0.39	0.017	76%
SSS → positive reinforcement → smoking	0.06	0.009	12%
SSS → negative reinforcement → smoking	0.05	0.009	9%
SSS → peer smoking → smoking	0.21	0.017	41%
SSS → peer smoking → positive reinforcement → smoking	0.03	0.004	6%
SSS → peer smoking → negative reinforcement → smoking	0.04	0.006	10%

Note. SSS = Sensation-Seeking Scale.

## Discussion

The primary aims of this study were to confirm the construct validity of the short form of the Smoking Consequences Questionnaire—Adolescent (Myers et al., 2003) in Hungarian adolescents and to provide evidence of the mediating role of outcome expectancies in the association between sensation seeking and smoking. Testing the construct validity of the questionnaire included both CFAs and examination of concurrent validity. Confirmatory analyses supported the original four-factorial structure in both smokers and nonsmokers. In the analysis of concurrent predictive validity, both positive and negative reinforcement expectancies predict current smoking status and nicotine dependence measured by the loss of autonomy to smoking, and the effect sizes of path coefficients are moderate or large. Negative consequences predict smoking status negatively; however, the effect size is small. The unexpected finding that appetite and weight control expectancies negatively predict smoking in boys, and are unrelated in girls, is due to statistical suppressor effects since the correlation analysis revealed that this expectancy is associated positively with smoking with medium effect size. The four expectancies scales explain a substantial proportion of the variance in smoking in both boys and girls and nicotine dependence in smokers.

The distal variable in this study was the sensation-seeking personality trait. Sensation seeking is associated with smoking and the effect size of the association can be regarded as at least medium or strong. In the present study, higher sensation seeking is associated with higher positive and negative reinforcement expectancies; however, sensation seeking is not associated with lower levels of risk perception measured by negative consequences of smoking. Therefore, high sensation seekers do not underestimate the health risks related to smoking. Our result

therefore supports the hypothesis that positive and negative reinforcement expectancies are important mediating factors between sensation seeking and smoking, and this result is in accordance with the association between impulsivity and expectancies (Doran et al., 2007). It seems feasible that sensation seeking may increase the activation of reinforcement expectancies in the memory of young adolescents and this activation contributes to the higher rate of smoking. It is also possible, however, that sensation seeking fuels experimentation with cigarettes at an early age and this leads to the implementation and activation of reinforcement expectancies. Further research is needed to support the notion that sensation seeking may influence the activation of reinforcement expectancies in the early stages of adolescence. It is also possible that high sensation seekers have a stronger sensitivity to nicotine (Perkins et al., 2000, Pomerleau, 1995) that provides the biological basis for the development of reinforcement expectancies, and stronger nicotine sensitivity leads to higher chance of development of nicotine addiction (Pomerleau, Collins, Shiffman, & Pomerleau, 1993).

Beside the expectancies, perceived peer smoking is also an important mediator between sensation seeking and smoking. Two main mechanisms can explain peer influence, namely peer pressure and peer selection (Hoffman, Monge, Chou, & Valente, 2007). Individual characteristics, like sensation seeking, might determine the selection of friends, who then provide a peer context that may or may not encourage smoking experimentation (Arnett, 2007; de Vries, Candel, Engels, & Mercken, 2006) or may convey the reinforcement expectancies. The present study and other studies support that perceived peer smoking mediates between sensation seeking and smoking (Wills et al., 1998; Yanovitzky, 2005). The present study also adds to an understanding of peer influence in that both positive and negative reinforcement expectancies also mediate between peer smoking and smoking. Peer influence might be a vehicle, which might transfer the information about reinforcement properties of smoking and other drug use (Hine et al., 2002, Romer & Hennessy, 2007). Peers can enhance the process of learning both negative and positive reinforcement, but the present study cannot answer the question of how the learning process takes place.

Although we cannot infer causality, this model describes the possible mechanism whereby sensation seeking increases positive and negative reinforcement expectancies and higher reinforcement expectancies foster cigarette use. Although the mediation is not perfect, it explains a substantially large and significant part of the association between sensation seeking and smoking. Nevertheless, this model helps our understanding of why highly sensation-seeking adolescents smoke more than their less sensation-seeking peers.

Some studies identify the effectiveness of programs targeting personality risk factors of drug use including alcohol, such as sensation seeking, anxiety, and hopelessness (Conrod, Stewart, Comeau, & Maclean, 2006). Brief personalized prevention work targeting risk-taking behaviors may 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 highly sensation-seeking teenagers. Public health communication campaigns targeting highly sensation-seeking adolescents have successfully reversed upward developmental trends in marijuana use among highly sensation-seeking adolescents and significantly reduced positive marijuana atti-

tudes and beliefs among them (Palmgreen, Lorch, Stephenson, Hoyle, & Donohew, 2007). A similar program might be useful in smoking prevention work targeting highly sensation-seeking adolescents.

## Limitations and directions for future research

There are two major limitations that need to be acknowledged and addressed regarding the present study. The first limitation is related to a possible sampling bias for several aspects. Many schools refused to participate in this study. Although this sample is geographically representative, we cannot exclude hidden factors, which may determine the participation of schools, for example, a more competitive school would not devote class hours to our study. The present sample is limited only to urban adolescents, therefore the generalizability to rural and minority adolescents is limited. The further potential bias is related to the lack of parental consent in 8.7% of the sample and being missing during the data collection in 9.2% of the sample.

The second limitation is related to the cross-sectional design in which the direction of causal relationship is uncertain. This study cannot explain whether the reinforcement expectancies are antecedents or consequences of smoking. If sensation seeking is considered to be a relatively stable personality trait, then we can outline three possible mechanisms. One possibility would imply that sensation seeking increases experimentation with smoking, which consequently strengthens or weakens the positive and negative reinforcement expectancies. According to the other possibility, sensation seeking generates stronger favorable expectancies. More favorable expectancies further increase the experimentation with smoking. 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 possible that both sensation seeking and reinforcement expectancies develop continuously owing to the continuously increasing disinhibition and experimentation with smoking during adolescence development. This study cannot address the issue of whether sensation seeking generally increases positive expectancies toward the use of psychoactive substances and other risk behaviors or if this effect is confined to certain drugs, that is, alcohol use and smoking only.

A further question remaining is which factors make highly sensation-seeking adolescents more vulnerable to believing more strongly in positive and negative reinforcements of smoking than their less sensation-seeking peers. One possibility is that sensation-seekers use information about the consequences of smoking selectively and are biased toward the positive messages with higher sensational values from the media (Stephenson & Palmgreen, 2001; Zuckerman, 1994) and probably from interactions with peers and adults. Moreover, since adolescents with high novelty seeking trait are more receptive to tobacco advertising strategies (Audrain-McGovern et al., 2003), it is also possible that sensation seeker adolescents are more prone to be faced with prosmoking attitudes and messages derived from tobacco marketing strategies fueling higher reinforcement expectancies. The other possibility is that they are more sensitive to the effects of smoking, at least during the early experimentation (e.g. Perkins et al., 2000); therefore, smoking has a greater impact on

the development of their expectancies. Understanding the development of reinforcement expectancies in highly sensation-seeking adolescents could help in the design of tailored prevention programs in order to allow these adolescents to benefit from their wonderful curiosity about various experiences and help them to avoid its harmful impact in relation to smoking.

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### Declaration of Interests

None declared.

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