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A Comparison of the Mediational Properties of Four Adolescent Smoking Expectancy Measures

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This prospective study compared the ability of 4 smoking expectancy measures to mediate the influence of peer, parent, and current smoking on adolescents' cigarette use 3 months later. No evidence for mediation was found when expectancies were operationalized as unidimensional subjective expected utility (SEU), multidimensional SEU, or unidimensional SEU decomposed into probability and desirability main effects and their interaction. Evidence for partial mediation was found for the decomposed multidimensional SEU measure. The results suggest that (a) peer and current cigarette use may influence future smoking indirectly through adolescents' probability estimates that smoking will control negative emotions and (b) the relationship between current and future smoking also may be mediated by adolescents' beliefs about the desirability of weight control.

An important assumption underlying many models of adolescent problem behavior is that expectancies are not only an important proximal cause of smoking, drinking, and drug use, but they also mediate more distal effects, such as temperament, community factors, family dynamics, and peer influence (Petraitis, Flay, & Miller, 1995). Although the *expectancy mediation hypothesis* appears to be widely accepted in the literature, direct empirical tests have been rare. In the present study we investigated whether smoking expectancies mediate the effects of three factors previously shown to predict adolescent smoking intentions: (a) peer smoking, (b) parent smoking, and (c) respondents' current smoking status (Biglan, Duncan, Ary, & Smolkowski, 1995; Chassin, Presson, Rose, & Sherman, 1996; Conrad, Flay, & Hill, 1992; Hu et al., 1995; Millar & Hunter, 1990). Furthermore, to determine whether these mediational effects generalize across different measurement approaches, we compare the mediational properties of four operationalizations of the smoking expectancy construct.

Measuring Smoking Expectancies

Several methods for assessing smoking expectancies have been used in the literature. One common strategy involves measuring expectancies in terms of unidimensional subjective expected utility (Bauman, Fisher, & Koch, 1989; Fishbein, 1982), hereafter referred to as *UD-SEU*. Although variations on this approach exist, typically respondents are presented with a list of possible smoking consequences and are asked to rate the probability and desirability of each. UD-SEU is computed by multiplying the probability and desirability (centered at 0) scores for each consequence and summing or averaging the products across all consequences. High UD-SEU scores indicate that the respondent believes the benefits of smoking outweigh the costs, whereas low scores suggest the opposite.

Although UD-SEU measures still occasionally appear in the literature, the current trend is to conceptualize smoking expectancies as a multidimensional construct (Brandon & Baker, 1991; Copeland, Brandon, & Quinn, 1995; Hine, Summers, Tilleczek, & Lewko, 1997; Velicer, DiClemente, Prochaska, & Brandenberg, 1985; Wetter et al., 1994). From a theoretical perspective, this reconceptualization suggests that individuals may base their smoking decisions on a series of implicit or explicit cost–benefit assessments on several consequence dimensions (e.g., health, social, weight control, etc.) rather than just making a single global assessment as suggested by the UD-SEU perspective. This view is also supported by our own informal analyses that indicate multidimensional SEU (MD-SEU) measures of smoking expectancies are much stronger predictors of smoking intentions and behavior than are UD-SEU.

A second important issue concerning the assessment of smoking expectancies relates to the proper manner of analyzing multiplicative composite variables such as UD-SEU and MD-SEU. Evans (1991) argued that multiplicative composites are best conceptualized as statistical interactions and, as such, are most appropriately analyzed in association with their corresponding main effects using hierarchical multiple regression. This is consistent with Cohen's (1978) definition of *interactions* as the amount of unique variance in a dependent variable accounted for by a multiplicative composite after statistically controlling for the main effects of the composite. When SEU is analyzed in isolation of the probability and desirability main effects from which it is derived, its meaning

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is unclear. It is impossible to determine if statistical relationships between SEU and other variables are due primarily to the main effects, the interaction of these effects, or both. Decomposing SEU helps disentangle these ambiguities.

We (Hine, Tilleczek, Lewko, McKenzie-Richer, & Perreault, 2002) provided a second compelling reason for decomposing multiplicative composites. Doing so appears to substantially increase prediction power. We compared a traditional composite measure of SEU to its decomposed counterpart in terms of their ability to predict smoking intentions and self-reported smoking behavior and found that decomposition resulted in more than a doubling in prediction power. Similar, although less dramatic, results have been reported by other researchers who have compared the predictive power of SEU and probability-based smoking expectancy measures. For example, Brandon and Baker (1991) found probability measures to be more sensitive than SEU measures in discriminating among daily smokers, occasional smokers, former smokers, triers, and never-smokers. Copeland et al. (1995) reported that probability measures performed better than MD-SEU measures in predicting nicotine dependence, negative affect, and several smoking cessation treatment outcomes. These studies suggest that decomposing SEU may boost prediction power even when only the probability main effect is entered into the prediction equation.

Smoking Expectancies as Mediators

We were able to locate only one study that investigated the mediational role of smoking expectancies: In a large sample of adolescents, Bauman et al. (1989) found no evidence that expectancies, assessed as UD-SEU, mediate the effects of parental attitudes, closeness with parents, curiosity, and previous experimentation with cigarettes on respondents' current smoking status. Although Bauman et al.'s null findings fail to support the expectancy-mediation hypothesis, they are by no means conclusive. In the paragraphs that follow, we outline several methodological issues that could account for their findings, and we outline a new study that addresses these issues.

One possibility is that Bauman et al.'s (1989) null findings stem from their use of a unidimensional, as opposed to a multidimensional, measure of smoking expectancies. As we noted earlier, unidimensional expectancy measures appear to be less powerful than multidimensional measures, decreasing the probability of detecting mediational pathways that may actually exist. Furthermore, the transformation of a multidimensional construct into a unidimensional one can obscure mediational effects that hold only for a subset of expectancy dimensions. For example, if the relationship between peer smoking and adolescent smoking is mediated by expectancies related to social costs and benefits, but not health or financial costs, then collapsing all four subscales into a single composite index such as UD-SEU may mask the significant dimensional effects. In the current study we investigated this possibility by including both univariate and multivariate smoking expectancy measures and comparing the mediational properties of each. If our reasoning is correct, we would expect to replicate Bauman et al.'s null results with our unidimensional expectancy measure but perhaps find evidence consistent with mediation for one or more the expectancy dimensions assessed by our multidimensional measures.

A second potential limitation of Bauman et al.'s (1989) study is that smoking expectancies were operationalized as a nondecomposed multiplicative composite. Given the statistical problems associated with analyzing and interpreting multiplicative composites (Evans, 1991), and recent empirical evidence suggesting that decomposed expectancy measures are better predictors of smoking intentions and behavior than traditional nondecomposed measures (Brandon & Baker, 1991; Copeland et al., 1995; Hine et al., 2002), it is possible that Bauman et al.'s null findings may simply reflect suboptimal measurement rather than a true absence of mediation. In the present study we tested this possibility by comparing the mediational properties of nondecomposed UD-SEU and MD-SEU measures to their decomposed counterparts. If Bauman et al.'s null results stem from their use of nondecomposed multiplicative composites, then in the current study we would expect to see stronger evidence for mediation for decomposed UD-SEU and MD-SEU than the nondecomposed measures.

A third potential limitation of Bauman et al.'s (1989) study involves their choice of distal variables: parental attitudes, parental closeness, curiosity, and previous experimentation with cigarettes. None of these four variables were strong predictors of their main criterion variable (smoking status), with Pearson *r*s ranging from .13 for parental closeness to .23 for parental attitude. Showing that expectancies do not mediate the influence of four relatively weak predictors of smoking behavior cannot be considered a fair test of the expectancy-mediation hypothesis. In the present study we addressed this limitation by including three distal variables identified by previous research as being moderate to strong predictors of future adolescent smoking: (a) peer smoking, (b) parent smoking, and (c) current smoking status of the respondent (Biglan et al., 1995; Chassin et al., 1996; Conrad et al., 1992; Hu et al., 1995; Millar & Hunter, 1990).

We have provided three plausible explanations for Bauman et al.'s (1989) finding that smoking expectancies are not important mediators of distal influences on adolescent smoking and designed a study to address these explanations. Evidence consistent with mediation will support the predominant view among smoking researchers that the impact of distal factors on smoking behavior, such as peer and parent influence, flow at least in part through smoking expectancies (e.g., Petraitis et al., 1995). Evidence inconsistent with mediation will suggest that this assumption may need to be reassessed.

Method

Sample

Participants were 486 students attending public schools in Northern Ontario, Canada, the same sample we used earlier (Hine et al., 2002). Ninety-five cases were lost to attrition over the course of the study. An additional 30 cases were deleted because of excessive (>5%) missing data, leaving a final sample of 361. No significant differences were found between the deleted and retained cases in terms of gender, age, and language; however, deleted participants were significantly more likely to be regular smokers than those who were retained. For all retained cases, missing data were replaced by the sample mean.

Of the final sample, 57% of the participants were female, and 43% were male. Twelve percent were in Grade 7, 14% were in Grade 8, 35% were in Grade 9, 14% were in Grade 10, 20% were in Grade 11, and 4% were in Grade 12. Their ages ranged from 12 to 19 years, with a mean of 14.82 years ($SD = 1.47$). Sixty-seven percent attended French schools, and 33%

attended English schools. French students completed a French language version of the questionnaire, whereas English students completed an English version. Two bilingual health professionals reviewed the questionnaires to ensure that the meaning of the items was equivalent across the two versions. Minor revisions were made in response to feedback provided by the reviewers.

Questionnaire Administration

The questionnaires consisted of more than 200 items assessing self-reported smoking status; smoking intentions; nicotine dependence; smoking expectancies; parents', siblings', and peers' smoking; family dynamics; attitudes toward smoking; and several demographic variables. Respondents took between 25 and 60 min to complete the surveys, with younger respondents taking slightly longer than older ones. Before receiving the questionnaires, students were informed that participation in the study was voluntary and that they were free to withdraw without incurring any penalty. None chose to do so. Questionnaires were completed in the schools, during class time, in the presence of at least one researcher and the classroom teacher. Participants were asked not to discuss their answers with others as they completed the questionnaires. To encourage accurate responding, respondents were told, both verbally by the questionnaire administrator and in writing, that their responses would be treated confidentially. All participants were assigned identification numbers to protect anonymity. Previous research suggests that adolescents provide accurate self-reports of smoking behavior under conditions similar to those in the current study (Murray, O'Connell, Schmidt, & Perry, 1983).

Measures

We assessed three distal influences of smoking behavior in this study: peer smoking, parent smoking, and current (Time 1 [T1]) smoking. Peer smoking was assessed with two items previously used by Stacy, Sussman, Dent, Burton, and Flay (1992): (a) "How many of your five closest friends have tried smoking cigarettes?" and (b) "How many of you five closest friends smoke at least one cigarette per week?" These two items were averaged to form a composite index (Cronbach's $\alpha = .71$).

Parent smoking was assessed with four items that inquired about the quantity and frequency of fathers' and mothers' smoking: (a) "How often does your father, step-father, or male guardian (mother, step-mother or female guardian) smoke cigarettes?" (1 = "never," 2 = "a couple times a month," 3 = "a couple times a week," 4 = "every day"); (b) "How much does your father, step-father, or male guardian (mother, step-mother, or female guardian) smoke?" (1 = "he/she does not smoke," 2 = "one to seven cigarettes per day," 3 = "half a pack per day," 4 = "one pack per day," 5 = "one and a half packs per day," and 6 = "two or more packs per day"). We standardized these items and averaged them to form a composite measure of parental smoking. Nineteen respondents indicated they did not have a father/stepfather/male guardian or that they did not have a mother/stepmother/female guardian. For this group, we computed parental smoking by averaging the standardized quantity and frequency measures for the parent that they did have. Cronbach's alpha for the parental smoking scale, based on the respondents who provided responses for both parents, was .79.

We assessed respondents' own smoking behavior with two items that asked about smoking frequency and quantity. On the basis of their responses, we classified participants into four categories of smoking frequency: (a) nonsmokers, (b) experimental smokers (smoked only once or twice in their lives), (c) occasional smokers (smoke occasionally, up to once or twice per week), and (d) daily smokers. These categories are similar, but not identical, to those used by Brandon and Baker (1991). Following Health Canada guidelines (Mills, Stephens, & Wilkins, 1994), we classified respondents into one of seven categories of smoking quantity: (a) 0, (b) 1–5, (c) 6–10, (d) 11–15, (e) 16–20, (f) 21–25, and (g) 26+ cigarettes per day. We computed composite measures of smoking behavior at T1 and Time 2 (T2; 3 months later) by standardizing and averaging the frequency and quantity measures (αs = .86 for T1 and .87 for T2 smoking).

To assess smoking expectancies, we presented respondents with 50 possible consequences of smoking cigarettes and asked them to rate the likelihood (1 = "very unlikely," 2 = "moderately unlikely," 3 = "moderately likely," 4 = "very likely") and desirability (recoded prior to the computation of SEU from a 1-to-4 scale to –1.5 = "very undesirable," –0.5 = "moderately undesirable," 0.5 = "moderately desirable," and 1.5 = "very desirable") of each. The smoking consequence items were generated from semistructured interviews with 40 adolescents (20 smokers and 20 nonsmokers), aged 12–18, attending middle school and high school in Northern Ontario, Canada. The resulting item pool covered 12 general categories of smoking expectancies: (a) health, (b) addiction, (c) negative physical feelings, (d) social costs, (e) financial costs, (f) performance decrements, (g) physical appearance, (h) social benefits, (i) weight control, (j) negative affect control, (k) positive affect, and (l) negative affect. Additional details about the development of this scale can be found in Hine et al. (2002).

We calculated an SEU score for each item by multiplying the likelihood and desirability ratings for each item. We computed a UD-SEU score for each respondent by averaging SEU scores across all 50 items. We computed decomposed UD-SEU by breaking UD-SEU into three components: (a) UD–probability, (b) UD–desirability (the average of the respondents' probability and desirability judgments across the 50 smoking expectancy items), and (c) UD–Probability × UD–Desirability (the cross product of UD–probability and UD–desirability, representing the interaction between the two variables). Following the recommendations of Aiken and West (1991), we centered UD–probability and UD–desirability at zero before computing the cross product.

The multidimensional SEU subscales used in this study were derived from previous factor analytic work by us (Hine et al., 2002). This work, which involved using Velicer's (1976) minimum average partial test to determine the number of factors to retain and a confirmatory factor analysis on an independent sample, suggested that a six-factor solution best fit the data. The six factors were (a) General Costs (8 items—stain fingers and teeth, bad breath, bad taste in mouth, smell bad, less spending money, perform less well at sports, hurt lungs, feel lethargic and unhealthy), (b) Social Benefits (7 items—look cool, gain respect of friends, fit in better with friends, look more attractive, increase status, gain respect of siblings, and increase probability of getting a boyfriend or girlfriend) (c) Social Costs (4 items—become less popular, feel like an outsider, lose respect of friends, lose respect of siblings), (d) Weight Control (4 items—control appetite, control weight, prevent weight gain, and prevent overeating), (e) Health Costs (4 items—heart disease, lung cancer, seriously damage health, die prematurely), and (f) Negative Affect Control (5 items—control or reduce anger, feel less stressed, relax, feel calm, feel good). Internal consistencies (Cronbach's alpha) for the MD-SEU expectancy subscales ranged from .66 for Weight Control to .90 for General Costs. A breakdown by French and English respondents produced almost identical alphas.

Finally, we computed decomposed MD-SEU scores by taking the average probability and desirability rating for each subscale and computing interaction terms using Aiken and West's (1991) approach, described above.

Results

T1 and T2 Smoking Behavior

On average, respondents smoked 2.37 ($SD = 4.91$) cigarettes per day at T1 and 2.59 ($SD = 5.51$) cigarettes per day at T2. At T1, 40% of the sample was classified as nonsmokers, 27% as experimental smokers, 10% as occasional smokers, and 23% as daily smokers. A similar distribution of responses was evident at T2 (41% nonsmokers, 26% experimental, 10% occasional, and 23% daily). Despite the relatively short timeframe of the study, 24% of the sample shifted smoking-frequency categories between T1 and T2.

Mediational Properties of Smoking Expectancies

We conducted four path analyses to determine whether smoking expectancies—operationalized as four types of SEU judgments—mediate the effect of peer, parent, and current smoking on future smoking. The first two analyses evaluated UD-SEU and MD-SEU as potential mediators. The third and fourth analyses examined the mediational properties of decomposed measures of UD-SEU and MD-SEU. Figure 1 provides an overview of the models tested in the study.

UD-SEU

Our first path model tested the hypothesis that parent, peer, and T1 smoking influence T2 smoking indirectly through respondents' global beliefs about the utility of using cigarettes (i.e., UD-SEU). According to the model, adolescents who smoke and have peers and parents who smoke will expect greater benefits from and fewer costs of smoking, reflected in a higher UD-SEU score, which in turn will be associated with higher rates of cigarette use at T2. Means, standard deviations, and simple correlations for the variables included in the path model are presented in Table 1. Direct, indirect, and total effects for the model are presented in Table 2.

The decomposed effects analyses reported in Table 2 reveal significant direct effects of peer, parent, and T1 smoking on T2 smoking but no significant indirect paths through UD-SEU. This pattern of results suggests that UD-SEU is not a mediator in the model we tested. This finding is consistent with findings reported by Bauman et al. (1989), who also operationalized smoking expectancies in UD-SEU terms.

Table 1
Correlations, Means, and Standard Deviations for the Unidimensional Subjective Expected Utility (UD-SEU) Mediational Model

Variable	1	2	3	4	5
1. Peer smoking	—				
2. Parent smoking	.20**	—			
3. UD-SEU	.15**	.03	—		
4. Time 1 smoking	.53**	.19**	.08	—	
5. Time 2 smoking	.55**	.23**	.12*	.82**	—
M	−0.01	−0.04	−1.92	−0.01	−0.01
SD	0.88	0.76	1.94	0.94	0.94

* $p < .05$. ** $p < .01$.

MD-SEU

Recent research suggests that smoking expectancies may be best conceptualized as a multidimensional construct, with each dimension accounting for unique variance in smoking intentions, behavior, or both (Brandon & Baker, 1991; Copeland et al., 1995; Hine et al., 2002, Velicer et al., 1985). This raises the possibility that the null results reported in our first analysis may simply reflect the failure of UD-SEU to adequately capture the conceptual richness of the expectancy construct.

An MD-SEU measure, which distinguishes among several distinct types of expected outcomes identified as important by adolescents, may represent a more effective and valid approach for assessing the mediational properties of smoking expectancies. For

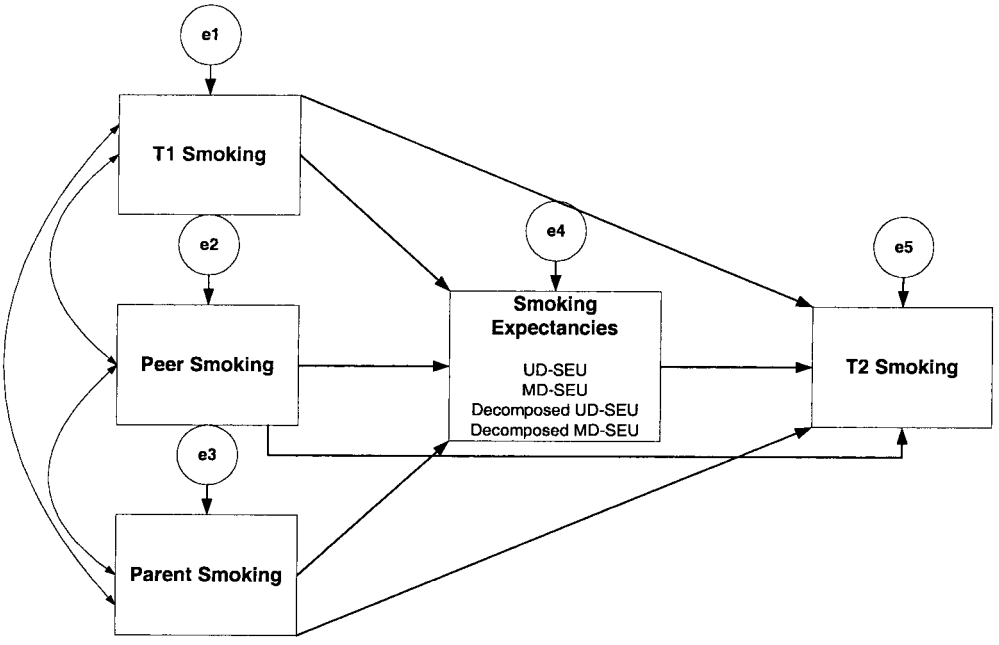

Figure 1. An overview of the mediational models tested in this study. The effects of current (Time 1 [T1]) smoking, peer smoking, and parent smoking on future (Time 2 [T2]) smoking are hypothesized to be partially mediated by smoking expectancies. The mediational properties of four smoking expectancy measures are compared: (a) unidimensional subjective expected utility (UD-SEU), (b) multidimensional SEU (MD-SEU), (c) decomposed UD-SEU, and (d) decomposed MD-SEU. e = error term.

Table 2
Direct, Indirect, and Total Standardized Effects for the Unidimensional Subjective Expected Utility (UD-SEU) Mediational Model

	Endogenous variables	
Causal variable	UD-SEU	Time 2 smoking
Peer smoking		
Direct effect	.15*	.15**
Indirect via UD-SEU	—	.01
Total effect	.15*	.16**
Parent smoking		
Direct effect	.00	.06*
Indirect via UD-SEU	—	.00
Total effect	.00	.06*
Time 1 smoking		
Direct effect	.00	.73**
Indirect via SEU	—	.00
Total effect	.00	.73**
UD-SEU: direct effect	—	.04

Note. Dashes indicate that the effect does not exist in the model. Significance tests for indirect effects were computed with the formula presented by Baron and Kenny (1986). Significance tests for the total effects were computed with multiple regression following the procedures described by Kline (1998, p. 151). Overall, the exogenous and mediator variables accounted for 70% of the variance in Time 2 smoking in this model.
* $p < .05$. ** $p < .01$.

example, social influence models of smoking (e.g., Sussman, Dent, Burton, Stacy, & Flay, 1995) suggest that normative social influence might lead adolescents who regularly socialize with smokers to anticipate more social benefits from and fewer social costs of smoking than adolescents with fewer smoking peers. Furthermore, informational social influence, the spread of knowledge and myths within smoking social groups, might cultivate expectancies and about other nonsocial benefits of smoking (e.g., weight and negative affect control). Firsthand experience of smoking benefits may further reinforce these expectancies, which in turn may encourage continued smoking.

We conducted a second path analysis to determine whether a multidimensional measure of smoking expectancies (MD-SEU) would exhibit better mediational properties than would UD-SEU. To maximize parsimony, only those SEU subscales that were significantly correlated with T2 smoking and at least one of the distal influence variables (i.e., peer, parent, or T1 smoking) were included in the model. Three SEU subscales met these criteria: (a) Social Costs, (b) Weight Control, and (c) Negative Affect Control. Means, standard deviations, and correlations for the variables in the second path model are presented in Table 3. A summary of the direct, indirect, and total effects associated with the model is presented in Table 4.

As was the case for UD-SEU, the MD-SEU analysis failed to provide any evidence of mediation. The effects breakdown reported in Table 4 once again revealed significant direct effects for peer, parent, and T1 smoking on T2 smoking but no significant indirect paths through any of the MD-SEU subscales. Although there are several significant paths from peer and T1 smoking to the MD-SEU subscales, none of the paths from MD-SEU to T2 smoking were significantly different from zero. This suggests that the mediational pathway is breaking down at the link between expectancies and T2 smoking. In other words, after controlling for the three distal influences, none of the MD-SEU subscales accounted for a significant amount of the residual variance in T2 smoking.

Decomposed UD-SEU

For the third path analysis, we broke down UD-SEU into three components: (a) UD–probability, (b) UD–desirability (i.e., the average of the respondents' probability and desirability judgments across the 50 smoking expectancy items), and (c) UD–Probability × UD–Desirability (the cross product of UD–probability and UD–desirability, representing the interaction between the two variables). As in the previous analyses, the three exogenous variables in the model were peer, parent, and T1 smoking, and the main criterion variable was T2 smoking. Means, standard deviations, and correlations for all the variables included in the path model are presented in Table 5, and an effects breakdown is presented in Table 6.

Like the previous analyses, the effects breakdown for our decomposed UD-SEU measure failed to reveal any significant indirect effects through the decomposed UD-SEU subscales. Thus, our proposition that the mediational properties of UD-SEU might possibly be improved by decomposing it into its main effects and interaction was not supported.

Table 3
Correlations, Means, and Standard Deviations for the Multidimensional Subjective Expected Utility (SEU) Mediational Model

Variable	1	2	3	4	5	6	7
1. Peer smoking	—						
2. Parent smoking	.20**	—					
3. SEU–SC	.18**	.04	—				
4. SEU–WC	.18**	.05	.15**	—			
5. SEU–NAC	.19**	.03	−.03	.51**	—		
6. Time 1 smoking	.53**	.19**	.11*	.23**	.23**	—	
7. Time 2 smoking	.55**	.23**	.14**	.25**	.24**	.82**	—
M	−0.01	−0.04	−2.29	−0.11	0.60	−0.01	−0.01
SD	0.88	0.76	2.58	2.96	2.94	0.94	0.94

Note. SC = Social Costs; WC = Weight Control; NAC = Negative Affect Control.
* $p < .05$. ** $p < .01$.

Table 4
Direct, Indirect, and Total Standardized Effects for the Multidimensional Subjective Expected Utility (SEU) Mediational Model

Causal variable	Endogenous variables: SEU–SC	SEU–WC	SEU–NAC	Time 2 smoking
Peer smoking				
Direct effect	.17**	.09	.09	.15**
Indirect via SEU–SC	—	—	—	.00
Indirect via SEU–WC	—	—	—	.00
Indirect via SEU–NAC	—	—	—	.00
Total effect	.17**	.09	.09	.16**
Parent smoking				
Direct effect	.01	.00	−.02	.06*
Indirect via SEU–SC	—	—	—	.00
Indirect via SEU–WC	—	—	—	.00
Indirect via SEU–NAC	—	—	—	.00
Total effect	.01	.00	−.02	.06*
Time 1 smoking				
Direct effect	.02	.19**	.19**	.72**
Indirect via SEU–SC	—	—	—	.00
Indirect via SEU–WC	—	—	—	.01
Indirect via SEU–NAC	—	—	—	.00
Total effect	.06	.19**	.19**	.73**
Direct effects				
SEU–SC	—	—	—	.02
SEU–WC	—	—	—	.04
SEU–NAC	—	—	—	.03

Note. Dashes indicate that the effect does not exist in the model. Significance tests for indirect effects were computed with the formula presented by Baron and Kenny (1986). Significance tests for the total effects were computed with multiple regression following the procedures described by Kline (1998, p. 151). Overall, the exogenous and mediator variables accounted for 70% of the variance in Time 2 smoking in this model. SC = Social Costs; WC = Weight Control; NAC = Negative Affect Control.
* $p < .05$. ** $p < .01$.

Table 6
Direct, Indirect, and Total Standardized Effects for the Decomposed Unidimensional (UD) Subjective Expected Utility Mediational Model

Causal variable	Endogenous variables: UD–P	UD–D	UD–P × D	Time 2 smoking
Peer smoking				
Direct effect	−.03	.10	−.01	.16**
Indirect via UD–P	—	—	—	.00
Indirect via UD–D	—	—	—	.01
Indirect via UD–P × D	—	—	—	.00
Total effect	−.03	.10	−.01	.16**
Parent smoking				
Direct effect	.00	.01	−.05	.06*
Indirect via UD–P	—	—	—	.00
Indirect via UD–D	—	—	—	.00
Indirect via UD–P × D	—	—	—	.00
Total effect	.00	.01	−.05	.06*
Time 1 smoking				
Direct effect	.01	.03	−.10	.73**
Indirect via UD–P	—	—	—	.00
Indirect via UD–D	—	—	—	.00
Indirect via UD–P × D	—	—	—	.00
Total effect	.01	.03	−.10	.73**
Direct effects				
UD–P	—	—	—	.03
UD–D	—	—	—	.01
UD–P × D	—	—	—	.00

Note. Dashes indicate that the effect does not exist in the model. Significance tests for indirect effects were computed with the formula presented by Baron and Kenny (1986). Significance tests for the total effects were computed with multiple regression following the procedures described by Kline (1998, p. 151). Overall, the exogenous and mediator variables accounted for 70% of the variance in Time 2 smoking in this model. P = probability; D = desirability (average of all probability and desirability ratings, respectively, across all the smoking expectancy items, centered at zero); UD–P × D = product of the average probability and desirability scores for each respondent.
* $p < .05$. ** $p < .01$.

Decomposed MD-SEU

Our final analysis involved decomposing the six MD-SEU subscales into their constituent main effects and interactions and testing these basic components as potential mediators. As with our previous analysis involving MD-SEU, only the variables that were significantly correlated with T2 smoking and at least one of the three distal-influence variables (i.e., peer, parent, and T1 smoking) were included in the model. Five variables met these criteria: (a) probability of social costs, (b)

Table 5
Correlations, Means, and Standard Deviations for the Decomposed Unidimensional (UD) Subjective Expected Utility Mediational Model

Variable	1	2	3	4	5	6	7
1. Peer smoking	—						
2. Parent smoking	.20**	—					
3. UD–P	−.02	−.01	—				
4. UD–D	.12*	.03	.32**	—			
5. UD–P × D	−.07	−.07	−.36**	−.19**	—		
6. Time 1 smoking	.53**	.19**	.00	.08	.05	—	
7. Time 2 smoking	.55**	.23**	.03	.10	.06	.82**	—
M	−0.01	−0.04	0.00	0.00	0.00	−0.01	−0.01
SD	0.88	0.76	0.62	0.73	0.53	0.94	0.94

Note. P = probability; D = desirability (average of all probability and desirability ratings, respectively, across all the smoking expectancy items, centered at 0); P × D = product of the average probability and desirability scores for each respondent.
* $p < .05$. ** $p < .01$.

weight control, and (c) negative affect control, and (d) desirability of weight control and (e) negative affect control. Means, standard deviations, and correlations for all the variables included in the path model are presented in Table 7, with direct, indirect, and total effects reported in Table 8.

This final analysis produced results consistent with partial mediation. In addition to significant direct paths from peer, parent, and T1 smoking to T2 smoking, three significant indirect paths were identified. The first two of these paths indicate that effects of peer smoking and T1 smoking on T2 smoking are mediated by perceived probability of negative affect control. More specifically, respondents with more friends who smoked, or were current smokers themselves, or both, believed that smoking was more likely to help them control negative emotions, such as stress and anger, than respondents with fewer friends who smoked, or who smoked less themselves, or both. In turn, respondents who believed that smoking was an effective way to control negative emotions were more likely to increase their smoking at T2. The third significant indirect path suggests that the effect of T1 smoking on T2 smoking was mediated by perceived desirability of weight control. Respondents who smoked more at T1 rated weight control as more desirable compared with those who smoked less at T1. In turn, stronger beliefs about the desirability of weight control were associated with increased smoking at T2.

Discussion

The primary aim of this study was to test the hypothesis that smoking expectancies mediate the effects of three distal influences (peer, parent, and current smoking) on adolescents' future smoking behavior. Four measures of smoking expectancies were used, and the mediational properties of each were compared. We found no evidence of mediation for three of the measures (UD-SEU, MD-SEU, and UD-SEU decomposed into main effects and an interaction); however, the fourth measure, decomposed MD-SEU, produced three significant mediational paths. The first two of these paths suggested that effects of peer and current smoking on future smoking are mediated by adolescents' expectancies about negative affect control, whereas the third path indicated that the relationship between current smoking and future smoking is mediated by adolescents' beliefs about the desirability of weight control.

Our findings provide added support for two views previously expressed in the literature. First, they support the view that smoking expectancies are most appropriately conceptualized as a multidimensional construct. Both of the UD-SEU measures evaluated in this study were weak predictors of smoking behavior and performed poorly as mediators. This indicates that adolescents' smoking decisions may not be based on a single, global assessment of potential smoking consequences (i.e., UD-SEU) or unidimensional judgments of probability, desirability, and their interaction (i.e., decomposed UD-SEU). Instead, our findings suggest that respondents' judgments about specific consequence dimensions—in particular, beliefs about negative affect control and weight control—represent the primary expectancy paths through which peer and current smoking exert their influence on future smoking.

Our findings also provide added support for Evans's (1991) view that multiplicative composites, such as SEU, should not be analyzed independently of their main effects. Evans's argument focused primarily on the difficulties associated with interpreting multiplicative composites given that they include a mixture of main effects and interactions. Our findings suggest an additional practical benefit associated with decomposition within the domain of smoking expectancies: Decomposed expectancies, particularly when they are also operationalized as multivariate construct, exhibit superior mediational properties than their nondecomposed counterparts.

What lies at the heart of the superior mediational properties exhibited by the decomposed multivariate expectancy measures used in this study? At present, we can offer no definitive answer to this question, but we suggest that the answer may be related to the increased prediction power associated with decomposed measures. According to Baron and Kenny (1986), two important prerequisites of successful mediation include that (a) variation in the mediator can be significantly predicted by variation in the independent variable or distal predictor and that (b) variation in a dependent variable can be accounted for by variation in the mediator. A perusal of the correlation tables for each of the path analyses conducted in this study reveals that the simple correlations between smoking expectancies and the other variables in the study were on average very small for both univariate and decom-

Table 7
Correlations, Means, and Standard Deviations for the Decomposed Multidimensional Subjective Expected Utility Mediational Model

Variable	1	2	3	4	5	6	7	8	9
1. Peer smoking	—								
2. Parent smoking	.20**	—							
3. P–SC	−.29**	−.08	—						
4. P–WC	.12*	.02	.23**	—					
5. P–NAC	.26**	.08	.12*	.58**	—				
6. D–WC	.16*	.07	.10	.49**	.39**	—			
7. D–NAC	.15*	.02	.16**	.36**	.52**	.64**	—		
8. Time 1 smoking	.53**	.19**	−.30**	.16**	.30**	.24**	.21**	—	
9. Time 2 smoking	.55**	.23**	−.25**	.21**	.35**	.26**	.20**	.82**	—
M	−0.01	−0.04	0.00	0.00	0.00	0.00	0.00	−0.01	−0.01
SD	0.88	0.76	0.86	0.90	0.86	1.28	1.30	0.94	0.94

Note. P = probability; D = desirability; SC = Social Cost; WC = Weight Control; NAC = Negative Affect Control.
* $p < .05$. ** $p < .01$.

Table 8
Direct, Indirect, and Total Standardized Effects for the Decomposed Multidimensional Subjective Expected Utility Mediational Model

Causal variable	Endogenous variables					Time 2 smoking
	P–SC	P–WC	P–NAC	D–WC	D–NAC	
Peer smoking						
Direct effect	−.19**	.05	.15*	.04	.06	.14**
Indirect via P–SC	—	—	—	—	—	.00
Indirect via P–WC	—	—	—	—	—	.00
Indirect via P–NAC	—	—	—	—	—	.02*
Indirect via D–WC	—	—	—	—	—	.00
Indirect via D–NAC	—	—	—	—	—	.00
Total effect	−.19**	.05	.15*	.04	.06	.16**
Parent smoking						
Direct effect	.00	−.02	.01	.02	−.03	.06*
Indirect via P–SC	—	—	—	—	—	.00
Indirect via P–WC	—	—	—	—	—	.00
Indirect via P–NAC	—	—	—	—	—	.00
Indirect via D–WC	—	—	—	—	—	.00
Indirect via D–NAC	—	—	—	—	—	.00
Total effect	.00	−.02	.01	.02	−.03	.06*
Time 1 smoking						
Direct effect	−.20**	.13*	.22**	.21**	.18**	.70**
Indirect via P–SC	—	—	—	—	—	.00
Indirect via P–WC	—	—	—	—	—	.00
Indirect via P–NAC	—	—	—	—	—	.02*
Indirect via D–WC	—	—	—	—	—	.01*
Indirect via D–NAC	—	—	—	—	—	−.01
Total effect	−.20**	.13*	.22**	.21**	.18**	.73**
Direct effects						
P–SC	—	—	—	—	—	.00
P–WC	—	—	—	—	—	.02
P–NAC	—	—	—	—	—	.10**
D–WC	—	—	—	—	—	.07*
D–NAC	—	—	—	—	—	−.07*

Note. Dashes indicate that the effect does not exist in the model. Significance tests for indirect effects were computed using the formula presented by Baron and Kenny (1986). Significance tests for the total effects were computed with multiple regression following the procedures described by Kline (1998, p. 151). Overall, the exogenous and mediator variables accounted for 71% of the variance in Time 2 smoking in this model. P = probability; D = desirability; SC = Social Costs; WC = Weight Control; NAC = Negative Affect Control.
* $p < .05$. ** $p < .01$.

posed univariate measures, larger for the nondecomposed multivariate measure, and larger still (although still only moderate in absolute terms) for the decomposed multivariate measure. This pattern is consistent with previous results reported in the literature suggesting that partial or full decomposition of SEU smoking expectancy measures is associated with increased prediction power (Brandon & Baker, 1991; Copeland et al., 1995; Hine et al., 2002). Although larger correlations between potential mediators and independent and dependent variables do not necessitate the presence of significant mediational paths, they do improve the chances of finding such paths, should they exist.

Limitations and Future Research

When considering the implications of this study, one should keep in mind several important points. First, given that direct effects of peer and current smoking on future smoking remained statistically significant after controlling for the indirect paths through decomposed MD-SEU, our results are consistent with partial, not full, mediation. This suggests that a substantial amount of the influence of peer and current smoking on future smoking is either direct (i.e., unmediated by other variables) or mediated by variables not included in our models. This second explanation strikes us as more plausible given the plethora of alternative proximal, cognitive-based mechanisms that have been linked to adolescent substance use (e.g., smoking prevalence estimates, perceived normative pressure, motivation to comply with the wishes of others, refusal self-efficacy, use self-efficacy, etc.).

Second, although we used a prospective design, our results do not provide unambiguous evidence regarding the direction of causal flow in our models. Given that only two time points were assessed, it is impossible to determine whether the causal path flows from peer and T1 smoking through expectancies or vice versa. A case could certainly be made that expectancies play a role in the selection of smoking and nonsmoking peers, and many researchers now agree that there is likely a reciprocal relationship between expectancies and other adolescent risk behaviors (e.g., Gerrard, Gibbons, Benthin, & Hessling, 1996). New prospective studies involving at least three time points are required to clarify the direction of causality.

Finally, it is important to note that although we found evidence to support the mediating role of smoking expectancies, these effects were quite small in terms of effect size—that is, these effects accounted for only a small fraction of the total effects of peer, parent, and T1 smoking on T2 smoking. There are several possible explanations for the small indirect effects observed in this study. One possibility is that smoking expectancies may not be especially important mediators of the distal influences examined in this study. As noted above, perhaps variables other than expectancies play a more critical role.

Another possibility is that the relatively short timeframe used in this study (3 months) may have prevented strong mediational effects from emerging. In our path models, the direct paths between smoking SEU (however it was defined) and T2 smoking represents the amount of unique variance in T2 smoking accounted for by SEU after statistically controlling for the other variables in the model. Given that T1 and T2 smoking were highly correlated, there was only a moderate amount of residual variance in T2 smoking left to be explained by expectancies.

A final possibility is that smoking expectancies do in fact constitute an important mediating mechanism, but the measurement approaches used in this study failed to assess this construct adequately. Alternative approaches to expectancy assessment that incorporate implicit memory (Stacy, 1997) and affect (Damasio, 1994) may produce stronger effects and should be investigated in future research.

References

Aiken, L., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Thousand Oaks, CA: Sage.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182.

Bauman, K. E., Fisher, L. A., & Koch, G. G. (1989). External variables, subjective expected utility, and adolescent behavior with alcohol and cigarettes. *Journal of Applied Social Psychology, 19,* 789–804.

Biglan, A., Duncan, T. E., Ary, D. V., & Smolkowski, K. (1995). Peer and parental influences on adolescent tobacco use. *Journal of Behavioral Medicine, 18,* 315–330.

Brandon, T. H., & Baker, T. B. (1991). The Smoking Consequences Questionnaire: The subjective expected utility of smoking in college students. *Psychological Assessment, 3,* 484–491.

Chassin, L., Presson, C. C., Rose, J. S., & Sherman, S. J. (1996). The natural history of cigarette smoking from adolescence to adulthood: Demographic predictors of continuity and change. *Health Psychology, 15,* 478–484.

Cohen, J. (1978). Partialed products of interactions: Partialed powers are curved components. *Psychological Bulletin, 85,* 858–866.

Conrad, K. M., Flay, B. R., & Hill, D. (1992). Why children start smoking cigarettes: Predictors of onset. *British Journal of the Addictions, 87,* 1711–1724.

Copeland, A. L., Brandon, T. H., & Quinn, E. P. (1995). The Smoking Consequences Questionnaire—Adult: Measurement of smoking outcome expectancies of experienced smokers. *Psychological Assessment, 7,* 484–494.

Damasio, A. (1994). *Descartes' error: Emotion, reason and the human brain.* London: Papermac.

Evans, M. G. (1991). The problem of analyzing multiplicative composites: Interactions revisited. *American Psychologist, 46,* 6–15.

Fishbein, M. (1982). Social psychological analysis of smoking behavior. In J. R. Eiser (Ed.), *Social psychology and behavioral medicine* (pp. 179–197). Chichester, England: Wiley.

Gerrard, M., Gibbons, F. X., Benthin, A. C., & Hessling, R. M. (1996). A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescents: What you do shapes what you think, and vice versa. *Health Psychology, 15,* 344–354.

Hine, D. W., Summers, C., Tilleczek, K., & Lewko, J. (1997). Expectancies and mental models as determinants of adolescents' smoking decisions. *Journal of Social Issues, 53,* 35–52.

Hine, D. W., Tilleczek, K., Lewko, J., McKenzie-Richer, A., & Perreault, L. (2002). *Expectancies and adolescent smoking: A comparison of four measurement approaches.* Manuscript submitted for publication.

Hu, F. B., Flay, B. R., Hedeker, D., Siddiqui, O., & Day, L. E. (1995). The influences of friends' and parental smoking on adolescent smoking behavior: The effects of time and prior smoking. *Journal of Applied Social Psychology, 25,* 2018–2047.

Kline, R. B. (1998). *Principles and practice of structural equation modeling.* New York: Guilford Press.

Millar, W. J., & Hunter, L. (1990). Relationship between socioeconomic status and household smoking patterns in Canada. *American Journal of Health Promotion, 5,* 36–43.

Mills, C., Stephens, T., & Wilkins, K. (1994). Summary report of the workshop on data for monitoring tobacco use. *Chronic Diseases in Canada, 15,* 105–110.

Murray, D., O'Connell, C., Schmidt, L., & Perry, C. (1983). The validity of self-reports by adolescents: A re-examination of the bogus pipeline procedures. *Addictive Behaviors, 12,* 7–15.

Petraitis, J., Flay, B. R., & Miller, T. Q. (1995). Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. *Psychological Bulletin, 117,* 67–86.

Stacy, A. W. (1997) Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology, 106,* 61–73.

Stacy, A. W., Sussman, S., Dent, C. W., Burton, D., & Flay, B. R. (1992). Moderators of social influence in adolescent smoking. *Personality and Social Psychology Bulletin, 18,* 163–172.

Sussman, S., Dent, C. W., Burton, D., Stacy, A. W., & Flay, B. R. (1995). *Developing school-based tobacco use prevention and cessation programs.* Thousand Oaks, CA: Sage.

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika, 41,* 321–327.

Velicer, W. F., DiClemente, C. C., Prochaska, J. O., & Brandenberg, N. (1985). Decisional balance measure for assessing and predicting smoking status. *Journal of Personality and Social Psychology, 48,* 1279–1289.

Wetter, D., Smith, S. S., Kenford, S. L., Jorenby, D. E., Fiore, M. C., Hurt, R. D., et al. (1994). Smoking outcome expectancies: Factor structure, predictive validity, and discriminant validity. *Journal of Abnormal Psychology, 103,* 801–811.

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