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Young adults' judgments of the costs and benefits of smoking: The predictive efficacy of different outcome weightings in behavioral decision making

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Abstract

Given the public health burden of smoking and the knowledge that many smokers begin during adolescence and young adulthood, understanding how decisions about smoking behaviors are made is of considerable importance. Most health decision-making models relevant to understanding smoking behavior posit that beliefs about the costs and benefits of smoking are an important influence on decision making. However, these models differ in how other factors (e.g., outcome importance, perceived positivity or negativity of outcome) are weighted in cost-benefit analyses. We examined the relative efficacy of different weightings in cost/benefit formulations to predict young adults' current smoking behavior and intentions to smoke in the future. Smoking and non-smoking participants listed advantages and disadvantages of smoking and then rated the importance and positivity/negativity of each outcome. Number of consequences listed, consequences weighted by importance, by positivity/negativity, and by an importance $\times$ positivity/negativity interaction were examined as predictors of both current smoking status and reported intentions to smoke in 5 years. Both importance and positivity/negativity (but not their interaction) predicted current smoking status, whereas importance alone was the strongest predictor of future smoking intentions. This suggests the possibility that different decision-making processes might underlie future behavioral intentions relative to those that guide current behavior.

Keywords

Smoking; smoking behavior; prevention; United States

Introduction

Smoking behavior leads to the death of over 400,000 people in the United States each year (1). The dangers of smoking are widely publicized and smokers are generally aware of these dangers (2-3). Nevertheless, there are currently about 46.5 million adult smokers in the United States (1). Although a number of factors may contribute to smokers' behavior in the face of risk (e.g. tendency of smokers to believe the risk applies more to other smokers than to themselves (4)) smoking is an individually chosen and maintained behavior. Therefore, the individual smoker's decision making about ongoing smoking is likely a key force guiding behavior.

Given the public health burden of smoking and the knowledge that many smokers begin during adolescence and young adulthood, understanding how decisions about smoking behaviors are

made is of considerable importance. What do smokers consider when making the decision to continue smoking? Many theories of behavioral decision making posit that cost/benefit analyses underlie individuals' behavioral choices. According to these theories, when making a decision individuals consider potential positive and negative outcomes of various courses of action and choose the option with the optimal cost benefit ratio (5,6). Such cost/benefit analyses are common in health decision-making theories (7). For example, the theory of reasoned action and theory of planned behavior include a cost/benefit analysis in their conceptualization of attitude toward the behavior (8); relative expectations of positive and negative consequences resulting from the behavior determine one's attitude about a behavior. This operationalization of attitude has been successfully used to predict smoking in both adolescents and adults (9-16). The transtheoretical model (17) and health belief model (18) also include cost/benefit components and have been successfully applied to the prediction of smoking behavior (19, 20).

To the extent that perceived costs and benefits influence decisions about health behavior, understanding adolescent and young adult smoking behavior requires examining what cost/benefit computations are associated with individuals' actual smoking behavior and behavioral intentions. Across studies, a variety of cost/benefit computations have been proposed, almost all based on presenting participants with a list of potential benefits and costs of smoking and having them rate the items on one or more dimensions. At the simplest level, some studies have simply asked participants how strongly they agree that each item is a cost or a benefit—essentially, how many costs and benefits of smoking do you see (21). Others have assessed one or more beliefs about each cost or benefit; e.g., importance to the participant, degree of positivity/negativity felt about the item, likelihood of the consequence accruing from smoking (22-26). Finally, some researchers have had participants rate the outcomes on one or more dimensions but have then created a multiplicative composite by taking the product of two of the measures as a composite rating of beliefs about the outcome (27).

Although all these approaches have been examined in the literature and all can predict at least some of the variance in smoking behavior, to our knowledge different weightings of cost/benefit analyses have not been directly compared. In particular, we do not know which best models the individual's own internal decision-making computations. This may be particularly important because some common formulations may not effectively predict behavior. In particular, multiplicative analyses have been both criticized on statistical grounds (28-29) and at times do not significantly improve prediction over and above the individual components making up the multiplicative composite (30)—see (31) for an opposing view. A direct comparison of these strategies and examination of which computation best accounts for variance in smoking behavior would address these questions.

Given the importance of understanding how individuals make cost/benefit computations, we designed a study to examine the efficacy of four different ways of operationalizing cost/benefit beliefs. To accomplish this goal, we asked both smokers and non-smokers to generate their perceived benefits and costs of smoking. Because our focus was on understanding how individuals themselves “compute” cost/benefit beliefs, we used an open-ended format to capture those beliefs that were most salient to the participants (32,33) and thus were most likely to guide decision making (34). We then asked participants to rate their perceptions of the importance and positivity/negativity of each listed outcome. These two variables were selected because many weighed cost/benefit constructs in the extant literature are based on either importance (e.g., how much do you want or fear the outcome (31)) or positivity/negativity (e.g., how good or bad is the outcome (30)). We examined the ability of combinations of those ratings to predict current smoking status and future smoking intentions.

Methods

One hundred and fifty undergraduate participants (108 females, 42 males; mean age = 19.04; 94% Caucasian) from a large Midwestern university took part in the study in exchange for extra course credit. The participants completed the questionnaire in small groups. The experimenters told the participants that the study focused on beliefs about smoking. Participants reported their current smoking behavior and behavioral intentions for future smoking, then reported their perceptions of the benefits and costs of smoking. Participants were fully debriefed after completion of the questionnaire.

Perceptions of benefits/costs of smoking

In an open-ended format, participants reported benefits and costs of smoking that they believed to be important. For each type of outcome, the experimenters gave the participants a sheet with seven open boxes and asked them to generate up to seven advantages (disadvantages) and to write each in the boxes provided.

Outcome importance and magnitude of positivity/negativity

After the outcome-listing task, participants made two ratings for each outcome they generated. First the participants reported how important they perceived each outcome to be using a 5-point Likert-type scale with endpoints of 1 = not important and 5 = very important. Next, they rated how strongly positive or negative they saw each outcome as being. These responses were also made on a 5-point Likert-type scale with anchors of 1 = very negative and 5 = very positive. All the positivity/negativity ratings for listed cost items were reverse coded before analysis so that the higher numbers corresponded with increased perceived negativity.

Smoking behavior

Participants reported their current and past smoking behavior. First, the participants indicated their current smoking frequency by reporting how many cigarettes they smoked. Participants answered by circling one of 9 options: none (non-smoker), a few a month, a pack a month (20 cigarettes in a pack), somewhere between 5 and 20 cigarettes a week, 1-2 packs a week, 3-4 packs a week, 5-6 packs a week, and 1 pack a day. Next, participants reported whether they had smoked in the last 2 months, followed by whether they had ever been a smoker (both yes/no questions).

Behavioral intentions

Participants indicated their likelihood of being a smoker 5 years in the future using a 5-point Likert-type scale with endpoints of 1 = not at all likely and 5 = extremely likely.

Results

We first created a current smoking-status classification based on responses to the smoking status questions. Participants who reported both currently not smoking and never having been a smoker were categorized as non-smokers. Current smokers were those who answered “yes” to having ever been a smoker and reported smoking at least once in the last 2 months. Finally, participants who reported not currently smoking but answered “yes” to having ever been a smoker were categorized as former smokers. This resulted in a sample of 74 non-smokers, 47 current smokers, and 14 former smokers. The responses of the remaining 15 participants could not be categorized (e.g. answered no to ever smoking but reported smoking cigarettes in the last month) and were excluded from the analyses. In addition, former smokers were excluded because their small number made their inclusion as a separate category problematic. These criteria resulted in a final sample of 121 participants.

Cost/benefit analyses predicting current and future smoking

Having successfully differentiated current smokers from non-smokers, we next turned to an examination of which formulations of cost/benefit perceptions would best predict both current smoking status and intentions to smoke in 5 years. To accomplish this goal, we computed outcome cost/benefit variables using four different computation strategies.

First, we created advantage and disadvantage count variables, simple sums of the numbers of advantages and disadvantages the participants generated in the open-ended response task (a report of the categories of outcomes generated can be found in table 1). Second, positivity/negativity weighted advantage and disadvantage variables were created. Here we created a mean positivity/negativity score by summing the ratings of positivity or negativity of each generated advantage and disadvantage and divided each by the total number of listed advantage or disadvantage items. Third, we used the same strategy to calculate a mean importance-weighted variable for advantages and for disadvantages.

Finally, a positivity/negativity $\times$ importance variable was created. The positivity/negativity ratings and importance ratings were multiplied together for each generated advantage and disadvantage. These weighted ratings were then summed and averaged to form overall weighted positivity/negativity $\times$ importance measures of advantages and disadvantages. Table 2 presents a summary of means for each participant rating and results of an ANOVA comparison of ratings for current smokers versus non-smokers. Table 3 presents an example of how the data from one participant would be transformed to create these variables.

Having created the four operationalizations of cost/benefit beliefs, we then examined the predictive ability of each operationalization both for differentiating current smokers from non-smokers and for predicting participants' intentions to smoke in 5 years. We were interested both in how advantages and disadvantages would predict behavior and behavioral intentions (i.e., the significance of the individual slopes for advantages and disadvantages and in which type of cost/benefit formulation best predicted smoking behavior and behavioral intentions (i.e., the formulation which accounted for the most additional variance in behavior). For current smoking, these questions were examined using a series of logistic regressions with smoking status as the dichotomous criterion variable. For future smoking intentions, we conducted a series of multivariate linear regressions. In both cases, we examined the individual slopes for advantages and disadvantages and the amount of change in variance accounted for when a particular operationalization was added to the regression model.

Current smoking status

We first examined how well each cost/benefit formulation predicted current smoking behavior. As mentioned above, for each type of formulation we estimated a logistic regression model in which current smoking status (coded 0 for non-smokers and 1 for smokers) was regressed on the relevant perceived advantage and disadvantage variable (see table 4 for summary).

For the advantage and disadvantage count variables, both advantages and disadvantages were significant predictors of smoking status, although the advantages had a stronger influence on the odds ratio; advantage $b=0.76$, Wald $\chi^2(1) = 19.40$, $p < .001$; disadvantage $b=-0.30$, Wald $\chi^2(1) = 3.96$, $p < .05$. The overall model provided a good fit to the data, $\chi^2(2) = 27.09$, $p < .001$, correctly categorizing 71.1% of participants as smokers or non-smokers (relative to 61.2% correct for a null model).

We then turned to an examination of the positivity/negativity weighted variables. Here, only the advantages significantly predicted smoking status; $b=0.84$, Wald $\chi^2 = 8.9$, $p < .01$. By contrast, disadvantages were not significant predictors of current smoking status, $b=-0.26$, Wald $\chi^2 = 1.27$, ns. Overall, however, the model still provided a good fit to the data, $\chi^2(2) = 13.46$,

$p = .001$, with 65.8% of the cases correctly categorized (as opposed to 50.6% for the null model2).

For the importance-weighted variables, advantages were once again the only significant predictor, $b = 1.21$, Wald $\chi^2(1) = 17.11$, $p < .001$; whereas disadvantages did not differentiate smokers and non-smokers, $b = -0.30$, Wald $\chi^2(1) = .79$, ns. The importance-weighted model correctly categorized 73.8% of the participants, which was a significant improvement over the 51.3% predicted by the null model; $\chi^2(2) = 26.90$, $p < .001$.

Finally, an analysis of the positivity/negativity $\times$ importance model indicated that advantages significantly predicted smoking status; $b = 0.31$, Wald $\chi^2 = 29.57$, $p < .001$; whereas disadvantages were not significant; $b = .01$, Wald $\chi^2 = .08$, ns. Overall, the positivity/negativity $\times$ importance model correctly predicted 78.8% of participants (compared with 61.1% for the null model), which was a significant fit improvement, $\chi^2(2) = 46.19$, $p < .001$.

Given that all four models individually differentiated smokers from non-smokers, we next turned to an examination of which was the optimal set of predictors of current behavior. To do so, we first examined whether the positivity/negativity, importance, and positivity/negativity $\times$ importance variables could explain a significant amount of the variance in behavior over and above that accounted for by the simple count of listed advantages and disadvantages. Because simple counts are the starting point for weighting cost/benefit perceptions in most models, we used the amount of variance predicted by the simple count as a baseline for comparing the predictive ability of each formulation. To do this, a series of logistic regression models were estimated in which the simple count variables were entered on Step 1, and the relevant weighted variables (positivity/negativity, importance, or positivity/negativity $\times$ importance) were entered on Step 2. Examining the change in model fit from Step 1 to Step 2 revealed that both positivity/negativity and importance significantly improved prediction, $\chi^2 \Delta(2) = 13.17$ and 17.93, respectively, $p < .001$ for both. In both cases, only the advantages of smoking significantly predicted behavior, b s 0.41 and 0.51, respectively, both significant at $p < .001$. Adding the multiplicative term to the model including the individual terms did not significantly improve prediction, $\chi^2 \Delta(2) < 1$, ns.

Given that both positivity/negativity and importance significantly improved prediction, we then examined whether each significantly predicted additional variance when both the simple count and the other variable were entered on Step 1 and the other then added in Step 2. That the addition of both significantly improved prediction suggested that each independently contributes to the optimal prediction of smoking behavior, positivity/negativity $\chi^2 \Delta(2) = 13.03$, $p < .001$; importance $\chi^2 \Delta(2) = 8.99$, $p < .01$.

Future smoking intentions

We next turned to an examination of the ability of each cost/benefit formulation to predict participants' likelihood of smoking in 5 years 1. As with current smoking status, we examined both the efficacy of advantages and disadvantages as individual predictors of behavioral intentions and the overall variance accounted for by the model (the results of these models are summarized in table 5).

Only advantages of smoking predicted behavioral intentions for the advantage and disadvantage count variables. Participants listing more advantages reported being more likely to smoke in 5 years; $\beta = .45$, $t(116) = 3.21$, $p < .001$. By contrast, the number of disadvantages listed did not significantly predict future smoking intentions; $\beta = -.16$, $t(116) = -1.95$, ns. Overall, the advantage and disadvantage count model did significantly predict future intentions, $R^2 = .22$, $F(2, 116) = 16.17$, $p < .001$.

Turning to the positivity/negativity-weighted advantages and disadvantages, we found that only advantages significantly predicted behavioral intentions. Participants rating the advantages of smoking positively were more likely to intend to smoke in five years; $\beta = .40$, $t(74) = 3.72$, $p < .001$. Disadvantages did not significantly predict behavioral intentions; $\beta = -0.05$, $t(74) < 1$, ns. Overall, the model significantly predicted behavioral intentions, $R^2 = 0.15$, $F(2, 74) = 7.00$, $p < .01$. For the importance-weighted variables, both advantages and disadvantages significantly predicted intentions; advantages $\beta = .36$, $t(76) = 4.34$, $p < .001$; disadvantages $\beta = -.12$, $t(76) = -2.06$, $p < .05$. The overall model significantly predicted intentions to smoke, $R^2 = 0.24$, $F(2, 74) = 11.05$, $p < .001$.

Finally, we examined the predictive ability of the variables positivity/negativity $\times$ importance. Here, advantages but not disadvantages predicted the likelihood of smoking in 5 years; advantage $\beta = .36$, $t(74) = 3.34$, $p < .001$; disadvantage $\beta = .12$; $t(74) = -1.11$, ns. Overall, the model accounted for 14% of the variance in participants' behavioral intentions; $F(2, 74) = 6.04$, $p < .01$.

All four formulations significantly predicted smoking behavioral intentions, although for the most part this was due to the effects only of advantages rather than both advantages and disadvantages. To examine which of these four techniques best predicted future smoking intentions, we conducted a second set of analyses in which we examined how much additional variance the positivity/negativity, the importance, and the positivity/negativity $\times$ importance-weighted variables accounted for over and above the simple advantage and disadvantage count variables.

Both positivity/negativity and importance-weighted variables accounted for a significant portion of the variance over and above that accounted for by the simple count variables; positivity/negativity $R^2_{\text{CHANGE}} = 0.07$, $F_{\text{CHANGE}}(2, 73) = 3.25$, $p < .05$; importance $R^2_{\text{CHANGE}} = 0.12$, $F_{\text{CHANGE}}(2, 74) = 6.06$, $p < .01$. In both cases, an examination of the individual slopes revealed that only the advantages variable significantly contributed to the increased predictive ability; both advantage t s > 3 , p s $< .01$; both disadvantage t s < 1 , ns. By contrast, the positivity/negativity $\times$ importance-weighted variable did not significantly add to the prediction of behavioral intentions; $R^2_{\text{CHANGE}} = 0.003$, $F_{\text{CHANGE}}(2, 73) < 1$, ns.

The final step in examining prediction efficacy was then to examine whether either of the weighted variables (positivity/negativity, importance) added significantly to the prediction when both the simple count and the other weighted variable was accounted for (e.g., does positivity/negativity account for variance over and above importance and vice versa). Here, we found that adding positivity/negativity to a model already accounting for simple count and importance did not significantly increase prediction; $R^2_{\text{CHANGE}} = 0.02$, $F_{\text{CHANGE}}(2, 70) = 1.16$, ns. Adding importance to a model that already accounted for both simple count and positivity/negativity did significantly improve prediction; $R^2_{\text{CHANGE}} = 0.07$, $F_{\text{CHANGE}}(2, 70) = 3.59$, $p < .05$ suggesting that the importance variable and not the valance variable does better at predicting behavioral intentions.

Discussion

Given the centrality of cost/benefit analyses to formal models of health decision making, which features of costs and benefit formulations best predict current smoking status and intentions to quit smoking in the future? Our findings suggest that cost/benefit formulations differ in their predictive ability. Although all four formulations individually predicted behavior, examination of their relative efficacy revealed important differences. Indeed, the multiplicative formulation common in decision-making research did not significantly add to the prediction of smoking behavior over and above the components (positivity/negativity, importance) comprising it.

What, then, is the most efficacious cost/benefit formulation for predicting smoking behavior? Our findings suggest that the answer is “it depends”. For differentiating current smokers from nonsmokers, the combination of the independent effects of positivity/negativity and outcome importance (but not their multiplicative term) predicts more variance than either variable alone. By contrast, when predicting future smoking intentions, the finding that only importance significantly added to prediction suggests the possibility that individuals use different judgmental standards for forming intentions for future smoking than the standards that guide current behavior. It may be true that an optimal assessment of cost/benefit formulations is dependent on the behavioral outcome of interest.

Past studies on costs and benefits of smoking have often reported mixed results on the relation of cost/benefit perceptions to smoking behavior. Some research has suggested that benefits are more predictive of adolescent initiation of smoking, whereas disadvantages are more successful at differentiating adult smoking status and intentions to quit (35-36). Other research suggests that expectancies about positive outcomes (advantages) are better able to distinguish smoking status than are negative outcome expectancies—see (37) for a comprehensive review of the smoking expectancy literature. Differences in the predictive ability of various cost/benefit formulations might explain some of this variation in findings. In our study, advantages consistently predicted variance both in current behavior and in behavioral intentions. By contrast, the predictive efficacy of disadvantages was limited to two isolated cases—positivity/negativity count for current smoking and disadvantages weighted by importance for future behavioral intentions. Across studies, importance, desirability, positivity/negativity, and likelihood of costs and benefits have all been examined alone or in various combinations to predict behavior. Given our findings about the differential predictive ability of various measures, the specific combination of cost/benefit components assessed in a particular study may contribute heavily to the study's findings.

In future research, an explicit comparison of the outcomes considered and positivity/negativity and importance ratings for closed-ended versus open-ended assessments might clarify which types of predictors are most closely related to smoking behavior and behavioral intentions. In addition, future research might consider other features that might influence perceptions of outcomes of smoking (e.g., age of smoker, degree of dependence on nicotine).

In sum, these findings suggest the need to consider carefully the cost/benefit formulation used to predict smoking behavior. Judgments should be guided by the type of behavior one is trying to predict. In addition, the findings suggest that relying solely on a single value rating (either positivity/negativity or importance) may not be the most efficacious means of predicting smoking behavior. Depending on the type of outcome being assessed, both positivity/negativity and importance may contribute to individuals' decision making and behavioral patterns.

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Table 1

Categories of smoking advantages and disadvantages provided by participants. Numbers indicate number of times the category was listed

Advantages	Non-Smokers	Smokers
<i>Stress relieving</i>	19	32
<i>Something to do</i>	4	11
<i>Helps you to fit in</i>	22	20
<i>It looks cool</i>	9	2
<i>Get more breaks at work</i>	2	3
<i>Goes with alcohol</i>	1	5
<i>Feels good</i>	6	6
<i>Improves concentration</i>	2	1
<i>Helps you lose weight</i>	6	5
<i>Independence</i>	-	2
Disadvantages	Non-Smokers	Smokers
<i>Bad for your health</i>	73	44
<i>Addiction</i>	21	12
<i>People exclude you</i>	6	2
<i>Gives you shortness of breath</i>	10	15
<i>Looks bad</i>	38	26
<i>Tastes bad</i>	-	2
<i>Displeasing Others</i>	4	3
<i>Costs a lot</i>	37	33
<i>Puts others in danger</i>	31	3
<i>Smell bad</i>	56	34

Table 2

Means (standard deviations) for participant listing and ratings of advantages and disadvantages for each technique

Advantages		
	Non-Smokers	Smokers
Count **	1.15 (1.20)	2.36 (1.41)
Positivity/negativity ⁺	2.41 (.99)	3.18 (.89)
Important ⁺	1.94 (.97)	3.16 (.95)
Positivity/negativity × Importance **	2.81 (3.59)	9.37 (5.54)
Disadvantages		
	Non-Smokers	Smokers
Count	5.07 (1.54)	4.68 (1.3)
Positivity/negativity	2.11 (1.45)	1.81 (.81)
Important	4.26 (.82)	3.98 (.77)
Positivity/negativity × Importance	16.77 (7.40)	16.45 (5.65)

⁺ $p < .10$ * $p < .05$ ** $p < .01$

Table 3
Example of data transformations done to create weighted importance and positivity/negativity variables and the interaction for a single participant

	Rated Importance	Rated Positivity/Negativity	Recorded Rating for Costs	Sum Ratings / Total Listed		Importance × Positivity/Negativity Interaction
				Weighted Importance	Weighted Positivity/Negativity	
Listed Benefits				$(4+2)/2 = 4$	$(5+5)/2 = 5$	$4*5 = 20$
Stress relieving	4	5				
Improves concentration	2	5				
Listed Costs				$(3+2+1+4)/4 = 2.5$	$(5+3+3+5)/4 = 4$	$2.5*4 = 10$
Bad for your health	3	1	5			
Tastes bad	2	3	3			
Smells bad	1	3	3			
Dangerous to others	4	1	5			

Table 4

Standardized betas from logistic regressions for advantages and disadvantages predicting current smoking status

	Advantages	Disadvantages
Count	.76 ^{***}	-.30 [*]
Positivity/negativity	.84 ^{**}	-.26
Importance	1.21 ^{***}	-.30
Positivity/negativity × Importance	.31 ^{**}	.01

*
p < .05**
p < .01***
p < .001

Table 5

Standardized betas for advantages and disadvantages predicting the likelihood of smoking in 5 years

	Advant.	Disadvant.
Count	.45***	-.16
Positivity/negativity	.40***	-.05
Importance	.44***	-.21*
Positivity/negativity $\times$ Importance	.36***	-.12

*
 $p < .05$ **
 $p < .01$ ***
 $p < .001$