ORIGINAL ARTICLE

The Effects of Warning Smokers on Perceived Risk, Worry, and Motivation to Quit

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Abstract

Background Research concerning motives for smoking cessation has focused on beliefs (cognitions) that people have, especially risk perceptions, with less attention directed to worry (negative affect) concerning one's smoking.
Purpose We tested a manipulation to encourage smokers to think and worry more about their smoking behavior. We contrasted risk perceptions and worry as predictors of contemplation to quit smoking.
Methods Smokers were randomly assigned to two conditions in which they carried personal digital assistants for 2 weeks. When signaled, smokers read smoking consequence statements or daily hassle statements.
Results After 2 weeks, experimental smokers reported greater perceived risk and worry about developing a medical condition compared to control smokers. Both perceived risk and worry independently mediated the relationship between the experimental manipulation and increased contemplation to quit smoking; however, worry was the strongest mediator in a multiple mediation model.
Conclusion Worry may be foremost for motivating smokers to attempt quitting.

Keywords Smoking · Smokers · Motivation to quit · Worry about smoking · Perceived risk

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Introduction

The majority of the 45 million smokers in the United States do not try to quit during any year, even for a day [1]. Therefore, it is crucial to understand how better to motivate smokers to make a quit attempt. In a review of 35 articles investigating motivation to quit, McCaul et al. [2] found that health concerns were overwhelmingly the most common predictors of cessation motivation. Most of these publications involved retrospective and cross-sectional designs in which ex-smokers recall their reasons for quitting or current smokers describe reasons why they would like to quit and these reasons are correlated with their overall motivation to quit. As an illustration of a retrospective design, Orleans et al. [3] asked over 4,000 younger and older smokers who had tried to quit previously to rate the importance of six different quitting motives. Smokers of all ages ranked the top three quitting motives in the same order: effects on one's future health, effects on one's present health, and effects on others. Kviz et al. [4] conducted a study utilizing the cross-sectional approach, interviewing three different age groups of current smokers about their plans to quit. Health concerns strongly predicted plans to quit in the next 3 months for smokers of all ages.

In a few studies, researchers have asked smokers about reasons for quitting and then followed them over time to see who succeeded. Eiser et al. [5], for example, surveyed smokers who expressed interest in quitting, and then retested them 1 year later. Smokers chose their most important reason for quitting from a list of four possible explanations: health, cost, "because it's a dirty habit," and concern for others. Most participants chose health as the most important reason, with cost second. None of the reasons differentiated successful from unsuccessful quitters.

However, the experimenters also compared those smokers who *tried* to quit vs. those who had not. "Triers" were more likely to mention both health and social reasons than were "nontriers." Although smokers appear to be motivated by smoking-related health concerns, one's own general health is not a strong predictor of motivation to quit smoking. For example, Gregor et al. [6] found that perceived health predicts motivation to smoke to reduce negative affect and is unrelated to motivation to quit smoking. Prokhorov [7] also found that higher levels of physical illness were associated with lower levels of readiness to change.

Health concerns might be important predictors of quit attempts for at least two reasons. First, smokers may go through a rational decision process, focusing on their perceived risks of smoking-related illnesses and deciding to quit in order avoid such consequences. Second, smokers who consider smoking-related health issues may begin to *worry* about the consequences of smoking and worrying may prompt the decision to quit.

Risk, Worry, and Health Behaviors

Nearly all theories of health-protective behavior contain a risk element [8], but most ignore affect (e.g., worry). For example, the Health Belief Model (HBM; [9]) posits that in order to change health behaviors, one must first believe that the consequences of his or her current behavior (e.g., perceived risk) outweigh the benefits. The Transtheoretical Model [10], a stage model of behavior change, also proposes that knowledge of risk can move a smoker from merely thinking about quitting to taking concrete steps to quit. Consistent with these theories, perceived risk has been associated with several protective health behaviors such as mammography screening [11] and influenza vaccinations [12]. For smoking behavior, perceived risk correlates with intentions to quit [5], motivation to quit, and quit attempts [13]. Additionally, some data suggest that changes in risk produce changes in motivation [14, 15]. Given these outcomes, increasing one's risk perceptions about smoking should facilitate movement toward quitting [8, 16].

Researchers could also increase smokers' motivation to quit by increasing or creating worry about their smoking. Worry is a construct closely tied to risk perceptions (e.g., [17]) and can be thought of as cognition "colored by affect" [18]. Tallis and Eysenck [19], for example, suggest that worry contains an appraisal of risk elements (e.g., likelihood, loss). Furthermore, Slovic [20, 21] discusses the idea of "risk as feelings" in decision-making. Slovic et al. propose that two systems interact during the decision-making process, an analytical (i.e., cognitive) system and an experiential (i.e., affective) system. Feelings, which are part of the affective system, thus contribute to and guide decision-making (see [22]). In particular, some researchers have proposed that worrying can serve a constructive purpose. In a study by Szabo and Lovibond [23], participants recorded when they worried and what they were doing during those times. Forty-eight percent of worrisome thoughts reported reflected a problem-solving process. It is important to distinguish such worrying from an individual differences approach to worry. Worriers also report high levels of trait and state anxiety [24], and trait worry scales are correlated with anxiety, depression, and psychosomatic symptoms [25]. In the present study, we are not concerned with "worriers" and the myriad types of negative affect associated with pathological worriers, but rather worry specific to smoking only.

McCaul and Mullens [26] proposed that nonpathological worry could motivate self-protective behavior for several reasons, including (a) the experience of worry may add a cognition to one's storehouse of reasons to take health-protective action (see [27]), (b) worrying may keep an issue salient, serving as a persistent reminder about what one "should" do, and (c) worry may serve as a "cue to action," motivating attempts to manage the aversiveness of worrying. Similar to findings regarding risk perceptions, data illustrate the association of worry with several health-protective behaviors. For example, studies show that worry predicts uptake of mammography screening [28] and smokers' plans and desire to quit [29]. Moreover, Lipkus and Prokhorov [30] found that smoking-related worry, but not perceived risk, was associated with a stronger desire to quit smoking. Similarly, Dijkstra and Brosschot [31] discovered that worry about smoking consequences predicted quit attempts among cigarette smokers. The idea that worry might influence motivation to quit is also supported by a related individual differences literature on anxiety sensitivity—the tendency for people to fear experiencing anxiety. People who are anxiety-sensitive tend to be more motivated to quit smoking likely because such individuals are also anxious about their health [32, 33]. We would suggest that anxiety-sensitive persons are also likely to *worry* more about their health and about the consequences of smoking in that regard. Increased worry may in turn contribute to motivation to quit smoking.

Theory and data suggest that risk and worry could both be important in motivating smokers to quit. Indeed, numerous studies show that risk and worry are related to each other, with correlations averaging about 0.30 [34–36]. In summary, if one is interested in increasing smokers' motivation to quit, increasing risk perceptions and/or worry should theoretically be important. A likely way to increase risk and worry might be to confront smokers with information about the consequences of smoking. Although information about smoking consequences is readily available, most smokers probably avoid such information.

In a recent study, we tried to force smokers to confront information about their smoking [26]. In that experiment, we attempted to manipulate worry *without* influencing risk perceptions by asking college student smokers to read cards with relatively familiar information about smoking consequences and to "think about" the information four times a day for a week. Compared to smokers reading statements about studying, smokers in the smoking-card conditions reported significantly more worry about smoking consequences and, as expected, the cards did not influence perceived risk. Importantly, smokers in the smoking-card conditions reported greater motivation to quit than the control smokers, although this effect was weak ($p=0.06$).

The purpose of the current study was to directly compare cognition (risk perceptions) and affect (worry) as predictors of changes in contemplation to quit smoking. This experiment differs from McCaul et al. [26] in three important ways. First, personal digital assistants (PDAs) were used to present smokers with factual statements about the negative social, esthetic, and health outcomes of smoking. Thus, we confronted smokers with a combination of smoking risks (i.e., health, social, and esthetic risks). Second, we purposefully intended to change *both* risk perceptions and worry so that we could test their relative influence on changing motivation to quit. Therefore, the consequences statements included commonly known outcomes of smoking behavior (e.g., lung cancer), but also lesser known correlates (e.g., mental decline). And, compared to the procedures used in McCaul et al., we included more risk statements (20 vs. 8), asked participants to think about risk for 2 weeks rather than 1 week, and included approximately twice as many statements each recording day. Third, to reduce the possibility that smokers might avoid the consequences information, we asked participants to memorize the statements. We assumed that the recall instructions would produce greater rumination (an aspect of worry) than the "think about it" instructions used previously.

The design was a between-groups design including two groups of randomly assigned college student and community smokers. One group learned about the negative consequences of smoking (experimental) whereas the other group learned information about daily hassles (control). In both groups, smokers read statements over 2 weeks. Following the statements, participants answered questions assessing the worry these statements caused and the applicability of the statements to their lives. Additionally, all participants completed a pretest, posttest, and 6-month follow-up questionnaire. During the two assessment weeks, participants completed PDA questionnaires eight times daily. This study was approved by the Institutional Review Board of North Dakota State University.

Method

Participants

Approximately equal numbers of college student ($n=67$) and community smokers ($n=60$) were recruited. Four students and four community members were excluded because they did not complete week 2 of the protocol. The final sample included 119 daily smokers (51 male and 68 female) who averaged 26.33 years of age (SD=9.84) and were mostly single (75.6%). Smokers were 92.4% White with 7.6% being American Indian/Alaskan Native ($n=4$) or unidentified ethnicity ($n=5$). The student population was recruited from a biannual screening questionnaire administered in psychology classes at the beginning of semesters. Students who reported smoking more than four cigarettes a day were invited to participate. Students received either extra credit ($n=17$) or money ($80; $n=35$), or a combination of the two ($n=11$). Community smokers were recruited through a personal advertisement in the local newspaper and received money as compensation ($75–80).

To encourage compliance, participants received full compensation only if they completed 80% of the 84 PDA questionnaires. For each percentage point below 80% compliance, $2.25 or half an extra credit point was subtracted from the total compensation. Six community smokers and six student smokers fell below this cut-off. The overall student compliance ($M=86.0$%, SD=9%) was identical to the community compliance ($M=86.1$%, SD=13%).

Procedure

Participants came into the laboratory individually or in groups up to six and learned first that we would not ask them to change their smoking behavior. Participants were randomly assigned to the experimental or control conditions in a 2:1 ratio. More smokers were assigned to the experimental group to provide adequate power for within-group analyses. Experimental smokers ($n=81$) were told that the purpose of the study was to learn how to communicate smoking-related information to smokers. Control smokers ($n=38$) were told that the purpose of the study was to learn about daily hassles in smokers' everyday lives. After giving consent, smokers completed a pretest (see below). Participants were then asked to carry a PDA to read about the consequences of smoking (experimental) or daily hassles (control) eight times daily for week 1 and six times daily for week 2.

The experimenter conducted a 45-min training session to explain the procedures and technical administration of the PDA, using the Palm OS® Emulator. At the conclusion of training, each smoker was assigned a PDA and scheduled a return appointment for the following week. After week 1, all smokers returned to the laboratory to check in and get a

new PDA. Participants then completed the second and last week of recording and returned for a posttest. Approximately 6 months later ($M=6.60$ months, SD=1.03), participants were contacted by phone for a follow-up questionnaire. The recontact rate was 79.8%, with 95 (63 experimental smokers and 32 control smokers) of the 119 smokers successfully contacted. Approximately the same proportion of students (83%; $n=52$) and community smokers (77%; $n=43$) completed the follow-up, $\chi^2(1)<1$. t tests comparing pretest scores for those who did or did not complete the follow-up revealed only one significant difference. Smokers who did not complete the follow-up questionnaire reported thinking less about quitting ($M=5.96$, SD=3.18) than those who completed the questionnaire ($M=7.33$, SD=2.28), $t(117)=-2.41$, $p=0.017$.

Measures

Demographic Variables

Background data collected at pretest included age, gender, education, marital status, and ethnicity.

Current Smoking Behavior

We measured current smoking behavior at pretest with three questions: the age they started smoking, how many years they had smoked in their lifetime, and the number of cigarettes smoked per day.

Nicotine Dependence

We administered the Fagerström Test of Nicotine Dependence—Revised (FTND-R; [37]) at pretest. The FTND-R has six items (e.g., Do you smoke if you are so ill that you are in bed most of the day?) that are summed to create a score ranging from 1 to 10. Higher scores indicate higher nicotine dependence (alpha=0.64).

Contemplation to Quit Smoking

The contemplation ladder [38] assessed each participant's level of readiness to quit smoking at all questionnaire time points. The ladder is an 11-point scale ranging from 0 (no thought of quitting) to 10 (I'm taking action to quit). This scale has decent discriminant validity [39], is used widely in smoking research (e.g., [40–42]), and predicts smoking cessation [43].

Trait Worry

The Penn State Worry Questionnaire (PSWQ), administered at pretest, is a 16-item assessment of trait worry [44]. Items are phrased both positively (e.g., I do not tend to worry about things) and negatively (e.g., Many situations make me worry). Responses, ranging from 1 (not at all typical of me) to 5 (very typical of me), were summed and higher scores indicate higher trait worry (alpha=0.91). This measure of trait worry does not include any level of specific worry about smoking.

Smoking Worry and Risk Perceptions

Eight items assessed worry and risk perceptions about smoking. Worry was assessed at all time points and risk perceptions were assessed at pretest and posttest only. All items (except where indicated) used a seven-point response scale (1=never to 7=extremely). Four items assessed worry: two regarding worry about developing a medical condition (e.g., How worried are you about developing a smoking-related medical condition?) and two regarding worry about harming others (e.g., How worried are you that your smoking bothers nonsmokers?). We averaged the two items assessing worry about a medical condition (pretest $r=0.74$) and the two items assessing worry about harming others (pretest $r=0.73$) to create two composite scores. Four items assessed risk: two regarding percentage risk of developing a medical condition [e.g., On a scale from 0 (absolutely no chance) to 100 (guaranteed to happen), what are the chances that you might develop some type of cancer within your lifetime if you continue to smoke?] and two regarding risk to others (e.g., To what extent do you think your smoking can be harmful to others?). We averaged two items to create a composite score for percentage risk of developing a medical condition (pretest $r=0.77$) and two items to create a composite score for risk to others (pretest $r=0.54$).

Self-Efficacy to Quit Smoking

One item assessed self-efficacy to quit smoking at pretest and posttest [45]. Participants rated their level of confidence in their ability to quit, if they decided to do so, on a scale from 1 (not at all confident) to 10 (very confident). Other researchers [46–47] have used a similar 10-point scale. Borrelli and Mermelstein [46], for example, found that self-efficacy was a strong predictor of whether or not smokers could abstain (effect size $r=0.65$).

Possible Behavior Change

A single question, given at posttest, asked about changes in smoking behavior over the past week. Smokers who reported changes were asked to describe them. Changes were categorized as (1) quit, (2) thinking about/trying to quit, (3) more aware of smoking behavior, and (4) smoke more.

Recall of Statements

At the posttest, smokers tried to recall all of the consequence/hassles statements they had read using an open-ended format. Smokers were given recall credit if they recalled the general idea of the statement.

6-Month Follow-Up

The follow-up questionnaire first measured current smoking status. If a person reported no longer smoking, he or she was asked when and why they quit, and the call was completed. If a person was still smoking, he or she was asked the average number of cigarettes smoked per day, number of quit attempts and length of quit attempts since completion of the study, contemplation to quit smoking, worry about the effects of smoking and about developing a smoking-related medical condition, to describe the effects of the study, and to list any of the consequence/hassles statements they remembered.

PDA Procedure

Smokers read eight statements a day in week 1 and six statements a day in week 2. The reduction in statements from week 1 to week 2 was implemented to reduce the time commitment and thereby to facilitate adherence to the protocol. Smokers completed event-contingent, signal-contingent, and interval-contingent recordings [48] to reduce the predictability of recording times.

PDAs

Smokers carried a Zire 31® PDA manufactured by Palm® (United States). It measured 4.4 × 2.9 in. and weighed 4.1 oz. Satellite Forms 5.2™ software created the PDA database application used to collect the study data.

Event-Contingent Recording

Smokers completed a questionnaire after three "events": the first cigarette of the morning (morning questionnaire), the first cigarette of the afternoon (afternoon questionnaire), and the first cigarette of the evening (evening questionnaire). Participants were reminded of these event-contingent recordings by PDA alarms set for 10:30 A.M., 1:00 P.M., and 7:00 P.M. each day. The alarms were accompanied by a reminder that said, "REMINDER: Have you done your Morning [Afternoon, Evening] questionnaire?" Smokers had to complete the morning questionnaire before 12:00 P.M., the afternoon questionnaire between 12:00 and 5:00 P.M., and the evening questionnaire between 5:00 and 11:00 P.M. Otherwise, the recording was considered noncompliant. At each of these recordings, smokers read a statement and answered three questions described below.

Signal-Contingent Recording

Signaling was used four times a day in week 1 (random 1–random 4 questionnaires) and two times a day in week 2 (random 1 and random 2 questionnaires). Times for random signaling were computed by randomizing ±60 min around prespecified time points. For week 1, the times were around 10:30 A.M., 2:30 P.M., 5:00 P.M., and 8:00 P.M. For week 2, the times were 4:00 and 8:00 P.M. Compliance was defined as completing the recording within an hour of the signal. At the predetermined time, the PDA beeped and displayed a message that it was time to complete a random questionnaire. At each of these recordings, smokers read a statement and answered three questions.

Interval-Contingent Recording

A predetermined time recording was used once a day throughout the study. Smokers completed the interval-contingent questionnaire immediately before going to bed (end-of-day questionnaire). They were not reminded by a beep from the PDA for this recording, and compliance depended on responding between 8:00 P.M. and 4:00 A.M. At this recording, smokers read a statement and answered three questions.

PDA Questionnaire Structure

Participants read a statement about smoking (or hassles) for 15 s and were asked to memorize it. The order of statements was randomized. Twenty smoking consequence statements covered health, social, and esthetic risk of smoking. To lessen habituation to the statements over the course of the study, 12 statements were used in week 1 and the remaining eight in week 2. Statements were chosen based on data collected by [49] in which smokers described the types of smoking thoughts and worries they experienced daily. Daily hassles included 20 statements, drawn from the daily hassles scale [50], and covered stress, money, and worries. Again, 12 statements were used in week 1 and the remaining eight in week 2.

After reading a statement, participants answered three questions: (a) "How much does this statement worry you?" (0=not at all to 4=a great deal), (b) "How much does this statement apply to you?" (0=not at all to 4=a great deal), and (c) "What was the statement about?" For this last question, four responses were available, including one taken directly from the statement. Experimental smokers answered 98.3% (SD=3.94%) correctly and control smokers

answered 99.1% (SD=1.59%) correctly. "Worry" and "apply" scores were created for each individual statement by averaging across all smokers' ratings for that statement, resulting in 20 separate worry and apply scores.

Compliance

Overall, compliance for all participants was 86.10% over both weeks of the study. Analyses comparing student vs. community compliance, condition compliance, weekly compliance, day of the week (Monday, Tuesday, etc.) compliance, and day in the study compliance were not significant, all $ts < 1.00$ and $Fs < 1.44$. An analyses of variance (ANOVA) assessing questionnaire type, however, was significant, $F(7, 944) = 3.53$, $p = 0.001$. Post hoc analyses revealed generally that participants were less compliant on random 1 and morning questionnaires (i.e., earlier-in-the-day times).

Results

We recruited both college student and community smokers to increase the generalizability of the results. The two volunteer groups differed significantly on five out of 12 pretest variables. Specifically, the students (a) were younger, $F(1, 115) = 70.33$, $p < 0.001$, (b) were less addicted as tested by the FTND, $F(1, 115) = 27.91$, $p < 0.001$, (c) reported smoking fewer cigarettes in a typical day, $F(1, 115) = 16.01$, $p < 0.001$, (d) reported smoking for fewer years, $F(1, 115) = 67.53$, $p < 0.001$, and (e) were more confident that they could quit smoking, $F(1, 115) = 7.45$, $p = 0.01$. To ensure that the results for experimental vs. control comparisons were not due to differences among the volunteers, volunteer group was initially tested as a factor in the analyses, but it

made no difference in the outcomes, either as a main effect or interaction. Thus, only treatment condition is reported.

Pretest Questionnaire

One-way ANOVAs assessed pretest differences between conditions [1]. Table 1 presents the means and standard deviations for past smoking behavior and smoking beliefs and feelings. Only one pretest difference was found: Experimental smokers scored higher on trait worry (PSWQ scores), $F(1, 115) = 6.09$, $p = 0.02$, $d = 0.49$. Controlling for PSWQ scores did not change the outcomes for any of the subsequent analyses. We present the analyses without that covariate.

Immediate Effects of Statements

Experimental smokers reported more worry ($M = 2.49$, SD = 0.86) overall about the smoking statements than control smokers reading about daily hassles ($M = 1.76$, SD = 0.81), $F(1, 117) = 18.97$, $p < 0.001$, $d = 0.87$. Table 2 presents the mean worry scores for the experimental statements. Experimental smokers reported worrying most about the statement, "93% of lung cancer patients die within 5 years" and the least about the statement, "Nonsmokers are very aware when you have smoked; they can smell it." Overall, experimental smokers reported significantly more worry about health consequences ($M = 2.64$, SD = 0.89) than esthetic ($M = 2.27$, SD = 0.95) or social consequences ($M = 2.23$, SD = 0.93), $ps < 0.001$, $d = 0.40$ and 0.45, respectively. Experimental smokers also felt that the smoking statements applied to them more ($M = 2.29$, SD = 0.81) than controls smokers felt the daily hassles applied to them ($M = 1.95$, SD = 0.96), $F(1, 117) = 5.04$, $p = 0.03$, $d = 0.46$. Overall, experimental smokers felt that statements about social ($M = 2.34$, SD = −0.82) and health ($M = 2.32$, SD = 0.85)

	Experimental (n=81)	Control (n=38)
Age	26.00 (9.62)	27.03 (10.39)
Years smoked	10.72 (9.47)	10.67 (10.24)
Number of cigarettes smoked in typical 7-day	13.78 (7.75)	13.53 (7.41)
Addiction (FTND; 1–10)	3.57 (2.24)	3.18 (1.97)
Age smoking began	15.17 (2.72)	16.08 (3.51)
Self-efficacy/quitting (1–10)	6.91 (2.61)	6.76 (2.87)
Worry about medical condition (1–7)	4.09 (1.46)	4.12 (1.71)
Worry about harming others (1–7)	4.08 (1.51)	3.92 (1.67)
Risk of medical condition (%)	72.77 (20.43)	65.28 (19.11)
Risk to others (1–7)	4.96 (1.38)	4.83 (1.39)
Contemplation of quitting (0–10)	6.89 (2.43)	7.39 (2.75)
Penn State Worry Questionnaire* (16–80)	51.00 (12.60)	44.63 (13.42)

Table 1 Pretest scores for smokers in the experimental and control groups

Possible ranges for scaled measures are listed after the description

*p=0.02 for treatment condition difference

Table 2 Average worry reported for statements among experimental smokers

Statements	Worry (0–4)
93% of lung cancer patients die within 5 years[a]	2.88 (1.05)
Emphysema is a disabling and incurable disease that makes every breath a struggle as if you were breathing through a straw[a]	2.84 (1.04)
Smokers die on average 13 to 14 years earlier than had they not been smokers[a]	2.81 (1.03)
Smoking is related to brain damage and becoming senile[a]	2.76 (1.07)
Emphysema, an illness caused by smoking, often leads to an enlarged heart and ends in heart failure and death[a]	2.73 (1.04)
Smokers make up nine out of 10 bypass patients[a]	2.71 (1.06)
Smoking causes heart attacks, the leading cause of death in the U.S.[a]	2.70 (.96)
When smokers get older, their rate of mental decline is five times faster than nonsmokers[a]	2.61 (1.05)
When you smoke, you increase the likelihood of oral and gum cancers, which cause facial disfiguration and pain[a,b]	2.58 (.99)
Smoking causes your blood vessels to harden faster and makes blood clots two to four times more likely[a]	2.52 (.94)
Because of secondhand smoke, 3,000 nonsmokers die of lung cancer in the U.S. each year[c]	2.50 (1.10)
Smoking can cause bad breath, stain teeth, reduce your ability to taste foods, and irritate gum tissues[b]	2.48 (1.03)
About 20% of all deaths in the United States are caused by smoking[a]	2.46 (.98)
As little as a decade of smoking can be enough to leave lasting creases and wrinkles[b]	2.36 (1.12)
Passive smoking increases the risk of stroke by 80% in nonsmoking partners of smokers[c]	2.34 (1.06)
"Smoker's face," deep lines around the mouth and eyes and a grayish appearance, was added to medical dictionaries in 1985[b]	2.25 (1.09)
28% of smokers suffer colds and coughs regularly, compared with 7% of the general population[a]	2.21 (1.00)
Smokers in their 40s often have as many facial wrinkles as nonsmokers in their 60s[b]	2.16 (1.10)
The blood vessels in the eye are easily damaged by smoking, causing a bloodshot appearance and itchiness[b]	2.12 (1.04)
Nonsmokers are very aware when you have smoked; they can smell it[c]	1.85 (1.17)

[a] Health consequence statements

[b] Esthetic consequence statements

[c] Social consequence statements

consequences applied to them more than esthetic consequences ($M=2.18$, SD$=0.89$), ps$=0.01$, $d=0.19$ and 0.16, respectively.

Posttest Questionnaire

One-way analyses of covariance (ANCOVAs) were performed on posttest worry perceptions, risk perceptions, and self-efficacy measures (controlling for their pretest counterparts). Smokers in the experimental condition reported more posttest worry about developing a medical condition [adjusted (adj.) $M=5.06$, SD$=1.26$] than control smokers (adj. $M=4.28$, SD$=1.28$), $F(1, 115)=9.59$, $p=0.002$, $d=0.61$. They also reported greater perceived risk about the medical consequences of smoking (adj. $M=75.04$, SD$=15.79$) than control smokers (adj. $M=62.39$, SD$=1.28$), $F(1, 111)=15.71$, $p<0.001$, $d=0.80$. No significant effect was obtained for worry about others and perceived risk to others, ps>0.14, consistent with the lesser worry reported when they read social consequences statements. The self-efficacy difference between groups was not significant, although the means favored experimental smokers (adj. $M=7.46$, SD$=1.89$ vs. adj. $M=6.80$, SD$=1.95$), $F(1, 115)=3.03$, $p=0.09$, $d=0.35$.

At posttest, smokers listed as many smoking-related illnesses as possible. Experimental smokers listed more ($M=4.81$, SD$=2.13$) than control smokers ($M=3.34$, SD$=1.55$), $F(1, 117)=14.50$, $p<0.001$, $d=0.79$. Experimental smokers were more likely to mention lung cancer (81% vs. 50%), $\chi^2(1)=12.56$, $p<0.001$, phi (φ;)$=0.32$, cardiovascular illnesses (e.g., heart attack, 84% vs. 41%), $\chi^2(1)=13.17$, $p<0.001$, $\varphi;=0.33$, and other illnesses such as discoloration of skin (53% vs. 16%), $\chi^2(1)=7.31$, $p=0.007$, $\varphi;=0.25$. Taken together, these data indicate that the manipulation successfully created worry and perceived risk about oneself (but not others).

The critical initial question in this experiment is whether the risk/worry manipulation had an effect on contemplation to quit. The ANCOVA revealed that smokers in the experimental condition were closer to quitting at posttest (adj. $M=8.35$, SD$=1.98$) than control smokers (adj. $M=7.25$, SD$=2.01$), $F(1, 115)=7.82$, $p=0.006$, $d=0.56$.

Mediation Analyses

All mediation analyses controlled for pretest values of contemplation to quit and the mediating variables. Thus, the conceptual question is whether *changes* in worry and risk

predicted *changes* in contemplation to quit. Mediation analyses for worry about or perceived risk of harming others, and self-efficacy were not conducted because the manipulation had no or only weak effects on these constructs.

Because mediation analyses included pretest covariates, we used the bootstrapping procedure outlined by Preacher and Hayes [51] which statistically controls for covariates in the model. This procedure uses a bootstrapping resampling technique to create bias-corrected 95% confidence intervals (95%CI) for the indirect effects of the mediating variable. If the interval does not include zero, then the effect is

significantly greater than zero and considered to be a good mediator for the model. Use of bootstrapping is recommended due to greater power (relative to the Sobel method, [52]) for detecting mediated effects (see [53]). This recommendation is largely due to the assumption of the Sobel test that the sample size is large. As the sample size decreases, the Sobel test becomes less conservative [54].

Figure 1a, b displays the unstandardized coefficients for the separate mediation results for worry about and perceived risk of developing a medical condition, respectively. Figure 1a shows that smokers in the experimental condition reported more worry than smokers in the control
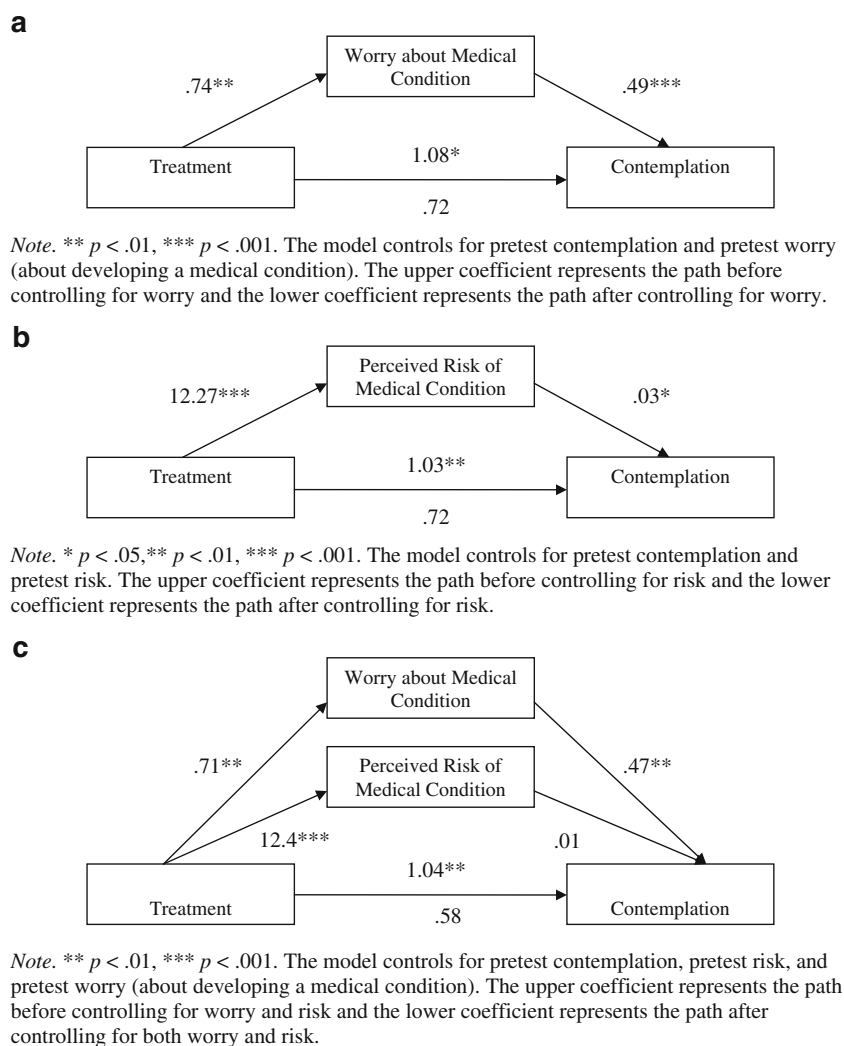
a

Note. ** $p < .01$, *** $p < .001$. The model controls for pretest contemplation and pretest worry (about developing a medical condition). The upper coefficient represents the path before controlling for worry and the lower coefficient represents the path after controlling for worry.

b

Note. * $p < .05$,** $p < .01$, *** $p < .001$. The model controls for pretest contemplation and pretest risk. The upper coefficient represents the path before controlling for risk and the lower coefficient represents the path after controlling for risk.

c

Note. ** $p < .01$, *** $p < .001$. The model controls for pretest contemplation, pretest risk, and pretest worry (about developing a medical condition). The upper coefficient represents the path before controlling for worry and risk and the lower coefficient represents the path after controlling for both worry and risk.

Fig. 1 a Relationship of treatment and contemplation to quit as mediated by worry about developing a medical condition (unstandardized estimates of effects). ** $p<0.01$, *** $p<0.001$. The model controls for pretest contemplation and pretest worry (about developing a medical condition). The *upper* coefficient represents the path before controlling for worry and the *lower* coefficient represents the path after controlling for worry. **b** Relationship of treatment and contemplation to quit as mediated by perceived risk of developing a medical condition (unstandardized estimates of effects). * $p<0.05$, ** $p<0.01$, *** $p<0.001$. The model controls for pretest contemplation and pretest risk. The *upper* coefficient represents the path before controlling for risk and the *lower* coefficient represents the path after controlling for risk. **c** Relationship of treatment and contemplation to quit as mediated by both worry and perceived risk of developing a medical condition (unstandardized estimates of effects). ** $p<0.01$, *** $p<0.001$. The model controls for pretest contemplation, pretest risk, and pretest worry (about developing a medical condition). The *upper* coefficient represents the path before controlling for worry and risk and the *lower* coefficient represents the path after controlling for both worry and risk

condition, $t(113)=2.96$, $p=0.004$. Smokers who worried more about their smoking also thought more about quitting, $t(113)=3.55$, $p<0.001$. Finally, when controlling for worry, the direct effect between treatment and contemplation to quit was no longer significant, $t(113)=1.88$, $p=0.06$. The bootstrapped estimate of the indirect effect of worry was significantly different than zero (95%CI=0.1189 and 0.7362), indicating that worry was a good mediator of this relationship. Table 3 presents intercorrelations for all constructs in the mediation models.

Figure 1b shows that smokers in the experimental condition reported greater perceived risk than control smokers, $t(109)=3.79$, $p<0.001$. Smokers who perceived greater risk about their smoking also thought more about quitting, $t(109)=2.09$, $p=0.04$. Finally, when controlling for perceived risk, the direct effect between treatment and contemplation to quit was no longer significant, $t(109)=1.66$, $p=0.10$. The bootstrapped estimate of the indirect effect of perceived risk was significantly different than zero (95%CI between 0.0403 and 0.7077), indicating that perceived risk was also a good mediator of this relationship.

An additional mediation analysis simultaneously included both worry and perceived risk about developing a medical condition (Fig. 1c). We used the multiple mediation procedure outlined by Preacher and Hayes [51]. This procedure also uses the bootstrapping resampling technique, but includes bias-corrected CIs for each specific indirect effect as well as a CI for the total indirect effect. Taken together, the combined indirect effect of both worry and risk mediated the effect of treatment on contemplation to quit (95%CI between 0.1001 and 0.9812). Thus, smokers in the experimental condition experienced more worry and perceived risk, which in turn, led to greater thinking about quitting. However, the specific indirect effects indicate that only worry was a good mediator (95%CI between 0.0835 and 0.7656). Risk did not contribute to the indirect effect of the condition–contemplation relationship when worry was taken into account (95%CI between −0.1702 and 0.4727).

In addition to the mediating analyses, we explored the effects of the following variables as moderators of the manipulation effect: pretest self-efficacy, trait worry, gender, volunteer group, age, nicotine dependence, and number of cigarettes smoked at pretest. No significant interactions resulted from any of these analyses.

Reported Behavior Change

At posttest, experimental smokers (64.2%) were more likely to report a change in their smoking behavior than control smokers (29.7%), $\chi^2(1)=12.13$, $p<0.001$, $\varphi;=0.32$. Specifically, 43 (53.1%) experimental smokers reported trying to quit vs. seven (18.9%) control smokers, $\chi^2(1)=12.14$, $p<0.001$, $\varphi;=0.32$.

Follow-Up

Nine of 63 experimental smokers (14.3%) and two of 32 control smokers (6.3%) reported quitting smoking, $\chi^2(1)=1.34$, $p=0.20$, $\varphi=0.12$. We added these individuals to those who said that they tried to quit at least once during the previous 6 months. Forty-five experimental smokers (67.4%) vs. 19 control smokers (59.4%) reported at least one quit attempt, $\chi^2(1)=1.40$, $p=0.20$, $\varphi;=0.13$. Among the 84 continuing smokers, none of the experimental–control differences were maintained over the follow-up period. Specifically, ANCOVAs controlling for pretest measures revealed no significant main effects for contemplation to quit ($F=1.40$) or for worry about developing a medical condition ($F<1$). Although posttest contemplation to quit was not associated with successful quitting at follow-up, $r=-0.09$, it was strongly associated with quit *attempts*, $r=0.42$. Additionally, no significant differences occurred for the number of cigarettes smoked per day or for the number of quit attempts, all $ps>0.10$.

Recall of Smoking Statements

At posttest and follow-up, smokers recalled the statements they received. Seventy-two percent of experimental smokers and 86.8% of control smokers could recall at least one

Table 3 Intercorrelations for constructs in mediation model

	1	2	3	4	5	6	7	8
1. Condition	–							
2. Pretest contemplation	−0.09	–						
3. Pretest worry about medical condition	−0.01	0.29***	–					
4. Pretest risk of medical condition	0.17	0.27**	0.26**	–				
5. Posttest contemplation	0.17	0.52***	0.34***	0.21*	–			
6. Posttest worry about medical condition	0.21*	0.06	0.64***	0.19*	0.37***	–	–	
7. Posttest risk of medical condition	0.39***	0.06	0.29**	0.59***	0.26**	0.26**	0.37***	–

*$p<0.05$, **$p<0.01$, ***$p<0.001$

message at posttest, $p=0.07$. At follow-up, none of the smokers was able to recall exactly what the statements said, but many remembered the general subject matter of statements. For example, a smoker might say that a statement was about "emphysema" or "smokers' face." Most experimental smokers were able to recall some type of health consequence statement (88.2%), followed by an esthetic consequence statement (39.2%), and a social consequence statement (17.6%). Only 10 control smokers were able to recall specific statement topics from the study. Most mentioned that the statements were generally about worry (60%)—30% of control smokers listed concerns about money and appearance, 20% listed job stress and loneliness, and 10% listed lack of sleep.

Discussion

The purpose of this study was to contrast the influence of risk beliefs vs. worry on cessation motivation. In contrast to most research in this area, we *manipulated* cognition and affect, rather than using the more typical correlational strategy (see [55]). Smokers who read warnings about various consequences of smoking reported greater worry and perceived risk about developing a medical condition due to their smoking compared to control smokers, although they did not report more worry or greater perceived risk about harming others. The warnings also produced stronger motivation to quit among experimental smokers at the end of the study compared to control smokers and more experimental smokers trying to quit during the experiment. Indeed, approximately half of experimental smokers reported trying to quit during the 2-week intervention (53%), much higher than control smokers (19%), especially given the nontreatment character of the study. Although we cannot definitively explain the high rate, we can entertain two possibilities. First, it is conceivable that the rate is attributable simply to the expansive definition of a quit attempt—smokers were counted in this category if they said they "tried" to quit, which could have ranged from a momentary decision to abstain to a serious, multiple-day quit attempt. Alternatively, it is conceivable that the manipulation did in fact create many serious, if short-lived quit attempts. Such may be the effects of increased worry.

Mediating analyses demonstrated that the key variable for increasing motivation to quit was the extent to which smokers worried about the health consequences of smoking. These results disappeared at the follow-up interview, approximately 6.5 months after the study's end. Moreover, it is important to note that the motivational effects of the warnings did not significantly affect quit attempts or smoking cessation following the study. Still, motivation to

quit predicted quit attempts for the sample as a whole during the follow-up interval ($r=0.42$). The latter data suggest that creating worry among cigarette smokers would motivate them to try abandoning the behavior, but the causal chain from warnings to worry to motivation to quit attempts has only modestly strong links, preventing the current study from revealing a behavioral effect. That is, the net effect of an experimental manipulation is the product of the intervening steps in the causal sequence [54]. In the present study, that chain runs from the manipulation to worry ($r=0.28$), from worry to motivation to quit ($r=0.36$), and from such motivation to behavior change ($r=0.42$). Multiplication of those terms yields a very small overall effect from the intervention to behavior ($r=0.04$). From a public health perspective, however, even small effects can be important.

A fair question to ask is why the effects of the warning messages failed to last. We can speculate about two possible reasons. A straightforward possibility is that warning messages only produce effects while they are actively processed. This notion suggests that the risk and worry effects would have disappeared rapidly, perhaps within days or a few weeks after the experiment ended. However, the warning messages did produce at least one effect that should have had more staying power: Experimental smokers were able to recall from memory many more smoking diseases than were control smokers. An alternative explanation, therefore, is that the effect of the warning messages eroded over a longer time period. The smokers in this study had been smoking on average nearly 11 years, and they probably had habitual ways of dealing with negative smoking-related information (e.g., avoidance). Following the study, it is probable that they either abruptly or gradually resumed their prestudy habits.

An interesting, though not surprising, finding in the present study is that some warnings produced more worry than others. We presented 20 statements to the experimental group (12 health, three social, and five esthetic), and experimental smokers reported more momentary worry about health statements than any other statement. These data fit with the findings of a review of connections between reasons for quitting and actual quitting [2]: Among 35 studies reviewed in that report, health concerns were the strongest motivator of quit attempts. Taken together with other data that smokers remain somewhat naïve about the consequences of their behavior (e.g., [56]), we suggest that continuing to focus on the devastating health effects of cigarette smoking is a valid public health approach.

This suggestion fits well with relatively recent changes in the warnings attached to cigarette packages. In Canada, for example, cigarette warning labels take up 50% of the front and back of the packages and display a graphic image with the written warning. Peters et al. [57] found that

smokers exposed to Canadian labels had stronger negative affective reactions to the labels than smokers exposed to U.S. labels. Additionally, smokers exposed to the Canadian labels also expressed more negative affect during exposure to smoking cues than smokers exposed to U.S. labels. In a retrospective analysis, Hammond et al. [58] contacted 191 former Canadian smokers and asked them about their motives for quitting. Thirty-one percent of the sample cited the new cigarette pack warning labels has having some influence on their motivation to quit.

Focusing on health is important because it influences worry, but it is curious in this regard that most theoretical models of health-protective behaviors pay little, if any, attention to affective constructs such as worry. Others have noted this dilemma. In a recent paper investigating a different health behavior context, Weinstein and colleagues [12] studied the extent to which various risk measures predicted (prospectively) whether or not respondents would obtain the flu vaccine. The best predictors of behavior were statements that included some type of affective wording (e.g., anticipated "regret," "feeling" at risk, "worry"; also see [59]). In short, evidence is accumulating showing that most health behavior theories are neglecting important affective variables.

A strength of this study is that the results held across a number of variables that one might intuitively think would moderate the motivational effects. Trait worry, for example, had no effect on the results. The worry that is important is specific to smoking. Similarly, other background variables such as smoking addiction and demographic variables (e.g., gender, age) failed to moderate the results. Additionally, the college students in the study behaved similarly to volunteers who were older, longer-term, and more addicted smokers. Thus, we suggest that our findings may generalize beyond the specific sample studied here.

In summary, this study shows that using warning messages to create worry moves smokers along a motivational continuum and closer to quitting. The importance of worry (and perhaps other feelings as well) needs to be incorporated in theories purporting to understand health-protective behavior. Risk messages are useful in creating worry, although we do not know precisely what features of such messages are important. The present research thus raises other questions: How often should risk messages be delivered to create worry? Could health professionals obtain similar effects with a single powerful personal warning? When will the effects of risk messages be maintained, how so, and for how long? Does hospitalization prompt worry about one's smoking and thus enhance cessation? Can this method of creating worry via risk messages be effective with other health behaviors such as marijuana or alcohol use? The answers to these questions are important because warnings can play a role in encouraging smokers to quit and thereby improve the public's health.

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