Pilot study of inducing smoking cessation attempts by activating a sense of looming vulnerability

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A R T I C L E   I N F O

A B S T R A C T

Despite widespread knowledge of the negative health consequences of cigarette smoking, in 2007 a majority (60%) of daily smokers in the USA did not make a quit attempt lasting at least 24 h. Drawing on Riskind's looming cognitive vulnerability model of anxiety, we developed a guided imagery induction intended to increase smokers' perceived susceptibility to the consequences of continued smoking and thereby to increase quit attempts. In a pilot study of this induction, 72 adult daily smokers were randomly assigned to the looming imagery condition or to a control condition exposed to guided imagery that did not concern smoking or its dangers. Those in the looming condition reported significantly higher state anxiety and highly accessible negative outcome expectancies for smoking immediately after the induction, and a significantly lower smoking rate in the month after the experiment. Nonsignificant trends favored the looming condition also for increasing contemplation of quitting, self-efficacy for abstaining from cigarettes, intrinsic motivation to quit as a function of health concerns, and most importantly the likelihood of making a quit attempt in the month following the experiment. Further development and testing of the looming induction as a way to motivate quit attempts is warranted.

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1. Introduction

Despite widespread dissemination of facts about the negative consequences of cigarette smoking, approximately one-fifth of American adults are current smokers (Centers for Disease Control and Prevention, 2008). A majority of daily smokers in the U.S. have no intention of quitting within 6 months (Wewers, Stillman, Hartman, & Shopland, 2003); that is, in the terms of the transtheoretical model (TTM; Prochaska & Velicer, 1997), they are "precontemplators." In terms of actual behavior, as opposed to intention, recent trends are unfavorable. In 2007, 40% of daily smokers in the US made a quit attempt lasting at least 24 h, down from 47% in 1993 and 44% as recently as 2006 (Centers for Disease Control and Prevention, 2008).

1.1. Threat appraisal

Health behavior change models such as the Protection Motivation Model (Floyd, Prentice-Dunn, & Rogers, 2000) and the Health Belief Model (Strecher, Champion, & Rosenstock, 1997) specify variables that may promote or inhibit smokers' progress toward making a quit attempt in response to concerns about the negative consequences of smoking. Applied to smoking, these models suggest that in response to a perceived threat smokers will be most likely to attempt to protect themselves by quitting (Norman, Conner, & Bell, 1999) if they believe their smoking is hazardous (threat appraisal), believe that their intended cessation strategy is effective, and are confident in their ability to follow through with this strategy.

Smokers' threat appraisals have typically been conceptualized as the perceived severity of the negative health consequences of smoking as well as perceived susceptibility to these consequences, consistent with data indicating that health concerns are cited as the most important reason for quitting (McCaul et al., 2006). Many large scale campaigns aimed at motivating smokers to quit have emphasized perceived severity, informing smokers of the potential fallout of smoking behavior, such as cancers or respiratory diseases.

One type of mass media campaign uses images of smoking-related diseases in order to reduce smoking. These images have been found to increase salience for these consequences, contemplation of quitting, and quit attempts (Borland et al., 2009; Hammond et al., 2007; Hammond, Fong, McDonald, Cameron, & Brown, 2003). However, use of such images has been criticized for lowering one's sense of personal risk as activated defense processes may result in the smoker

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dismissing this type of threat (Brown & Smith, 2007). These images represent a potential outcome that the smoker could experience if smoking continues, but there is a documented inclination among smokers to believe that they are less likely than the average smoker to experience negative health consequences (Weinstein, 2001).

1.2. Perceived susceptibility

For information about the severe negative consequences of smoking to have maximal impact, smokers must personalize it, gaining a sense of their own perceived vulnerability. Perceived susceptibility, i.e., "one's subjective perception of the risk of contracting an illness" (Strecher et al., 1997, p. 74), has been linked empirically with progress through the stages of change identified in the TTM (Prokhorov et al., 2003).

Traditionally, interventions have sought to enhance smokers' perceived susceptibility by increasing the smokers' perceived probability of contracting smoking-related illnesses. Several studies have included a biological screening for the risk of lung cancer to increase abstinence motivation (Ostroff, Buckshee, Mancuso, Yankelevitz, & Henschke, 2001; Sanderson et al., 2008). These interventions can certainly play a role in the effort to increase quit attempts, but they have apparent limitations as well. First, widespread implementation could be expensive, in view of the large population of smokers and numerous smoking-related diseases for which to screen. Second, smokers found to be at lower risk in such screenings could, if anything, show a decrease in the extent to which they contemplate quitting.

Given these possible drawbacks of biological screening, psychosocial interventions to increase perceived susceptibility should also be developed and evaluated. Copeland and Brandon (2000) had daily smokers watch videotaped interviews of others who had contracted smoking-related illnesses and then undergo their own interviews to try to personalize this information. By increasing smokers' perceived likelihood that they would suffer from smoking-related illness, it was found that smokers became more motivated to quit smoking, but this effect was not sustained over time (Copeland & Brandon, 2000).

1.3. Looming cognitive vulnerability model

Anxiety research suggests that a larger and more lasting effect on motivation to quit might be achieved by trying to enhance smokers' perceptions that the dangers to which they are susceptible are increasing, in contrast to relying on a more static appraisal of these dangers as highly probable and severe. The looming cognitive vulnerability model (LCVM; for review see Riskind, Williams, & Joiner, 2006) holds that anxiety is created by the perception that stimuli are dangerous and "are rapidly rising in risk as they approach through time or through space" (Riskind et al., 2006, p. 781). In other words, threat appraisal is not only composed of static appraisals of threat, such as perceived likelihood, but also entails how the individual perceives the threat as changing or escalating. According to this model, anxiety is associated specifically with perceiving a threatening stimulus as moving closer in space or time. As the person imagines the process by which a threat is approaching, anxiety increases. For example, a general, static perception that the world economy is fragile might arouse little anxiety, but a vivid image of an accelerating sequence of events threatening oneself (high rate of mortgage defaults–lower credit availability–lower business activity–recession–decreased consumer demand–declining revenues–layoffs–loss of my job–inability to pay rent–loss of home) would provoke high anxiety. The perception of looming vulnerability has been linked with several types of anxiety, including fear of spiders, fear of contamination, social anxiety, OCD, generalized anxiety, and PTSD (see review by Riskind & Williams, 2005).

The purpose of the study reported in this article was to develop and pilot-test an imagery intervention based on the looming vulnerability model as a way of increasing smokers' perceived susceptibility to negative health consequences and their state anxiety, with the effect of increasing contemplation of quit attempts and (preferably) actual quit attempts. Guided imagery interventions based on the looming vulnerability model have been used to decrease maladaptive anxiety. For instance, anxiety was reduced among participants with subclinical obsessive compulsive disorder by teaching them to "freeze" their looming images of increasing risk of spreading contamination (Riskind, Abreu, Strauss, & Holt, 1997). Conversely, our objective was to *increase* smokers' anxiety regarding an objectively dangerous situation, the health consequences of cigarette smoking, in the hope that this will motivate them to try to take protective action by attempting to quit smoking.

Using the looming cognitive vulnerability model as a basis for intervening to increase quit attempts offers two potential advantages. First, looming vulnerability has been associated with more sustained anxious responding to a stimulus (Riskind, 1999). Threats viewed as changing and escalating do not easily dissipate and are less apt to be diminished and ultimately ignored (Riskind, 1999). Second, looming cognitive vulnerability could serve to promote anxiety in smokers without decreasing self-efficacy (Riskind, Long, Duckworth, & Gessner, 2004; Riskind et al., 2006), which is important given that self-efficacy is a consistent predictor of successful smoking cessation. Typically, increased anxiety is associated with decreased self-efficacy among smokers (Dijkstra & Brosschot, 2003; Zvolensky, Bonn-Miller, Bernstein, & Marshall, 2006), but a clinician implementing a looming vulnerability intervention can control the movement and velocity of the threatening stimuli and can make the threatening consequences contingent on the individual's own behavior (Riskind et al., 2006). As such, the participant should retain the belief that averting the feared outcome by taking preventive action is something she or he can accomplish. Looming management techniques have been used before to increase self-efficacy and reduce perceived vulnerability to threatening stimuli (Riskind et al., 2004); therefore, we hypothesize that a looming vulnerability induction could increase anxiety about smoking-related illness while still preserving the belief that one can avoid these negative consequences.

1.4. Current study

In summary, we conducted a pilot study of a guided imagery intervention to induce a sense of looming vulnerability to the negative health consequences of smoking. To our knowledge, no previous studies have applied the looming cognitive vulnerability model to smoking or smoking cessation. Smokers were randomly assigned to receive either the looming intervention or a control (neutral) guided imagery exercise. The looming and control conditions were compared on several variables measured immediately after the induction: (a) state anxiety immediately after the induction, (b) contemplation of quitting smoking, (c) motivation to quit with specific reference to health concerns, (d) negative outcome expectancies concerning the health risks of smoking, and (e) self-efficacy. We also completed a one-month follow-up assessment as a preliminary examination of (a) the durability of any immediate effects on contemplation, motivation, and outcome expectancies, as well as (b) the impact of the induction on smoking rate and actual quit attempts in the intervening month.

2. Method

2.1. Participants

Participants ($N=72$; 32 female and 40 male) were recruited via newspaper ads. Inclusion criteria consisted of being (a) age 18 or older;

(b) able to understand spoken and written English, and a (c) daily cigarette smoker.[1] There was no mention of smoking cessation in the advertisements for the study, and participants were not required to be interested in quitting.

Participants ranged in age from 18 to 67 ($M = 46.63$, SD = 10.50) years. Most participants (97%) were not Hispanic or Latino. A majority ($n = 54$, 75%) were African American, with the remainder being White (15%), American Indian (1%), Native Hawaiian or Other Pacific Islander (1%) or Other race (7%). Almost all participants (96%) had completed high school, and about one-half (53%) reported having at least one year of college, though only 3% had graduated from college. Almost half of the participants reported being disabled and unable to work (19%) or unemployed (24%); only 33% were employed full-time. The median annual household income range was 20,000 to 30,000 dollars.

The sample reported having smoked daily for 1 to 53 years ($M = 27.11$, SD = 11.66), with a current rate of 3 to 35 cigarettes per day ($M = 12.88$, SD = 6.85). Their Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) scores reflected moderate nicotine dependence ($M = 4.64$, SD = 2.14). A majority (60%) of participants had attempted at least once to quit smoking. Prior quit attempts ranged from 0 to 20, with a median of 2. Among those who had tried to quit, the longest previous period of smoking cessation ranged from 1 day to 2 years, with a median of 90 days.

2.2. Measures

2.2.1. Demographics and smoking history

Demographics (10 items) and smoking (and smoking cessation) history (10 items) were assessed with brief, face valid questionnaires.

2.2.2. Nicotine dependence

The Fagerstrom Test of Nicotine Dependence (FTND; Heatherton et al., 1991) is a 6-item self-report questionnaire measure of the severity of dependence. The FTND has shown moderate internal consistency (alpha = .72; Weinberger et al., 2007), high 2–3 week retest reliability ($r = .88$) and convergent validity with cotinine levels ($r = .39$; Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). In our sample the FTND demonstrated modest internal consistency (alpha = .57).

2.2.3. State anxiety

State anxiety was measured with a single-item visual analogue scale (VAS) in which the participant makes a mark along a 100 mm horizontal line anchored by the phrase "Not at All" at the left (0) and "Extremely" at the right end (100), with the word "Anxious" printed above the line in the middle; the score is the number of millimeters from the left end at which the participant made the mark. Single-item visual analogue scales have proven useful as measures of acute anxiety in smoking research (Erblich, Boyarsky, Spring, Niaura, & Bovbjerg, 2003).

2.2.4. Outcome expectancies

Outcome expectancies for smoking were measured in two ways. First, on the premise that highly accessible expectancies regarding smoking may be the most influential in determining smoking-related behavior, we included a free-response "Self-Generated Outcome (SGO)" test (McKee, Wall, Hinson, Goldstein, & Bissonnette, 2003).

Participants complete the stem "When I smoke cigarettes, I expect to ….." Following McKee et al. (2003), we examined only the first response to this stem, and we had two raters code responses independently into one of four categories: *positive reinforcement* (e.g., good feelings resulting from smoking), *negative consequences* of smoking (e.g., burning sensation in throat, coughing), *negative reinforcement* (e.g., reduced anxiety) and *weight control*. These ratings proved to be highly reliable (kappa = .80). Disagreements were resolved by discussion between the raters. McKee et al. (2003) found this measure to be sensitive to current mood and to smoking status. Participants in a positive mood induction condition were more likely to generate positive reinforcement expectancies, while those in negative or neutral mood were likely to describe negative reinforcement or negative consequence expectancies. Current smokers were more likely to generate negative reinforcement expectancies, whereas former smokers were more likely to report negative consequence expectancies.

Second, the Smoking Consequences Questionnaire-Adult (SCQ-A; Copeland, Brandon, & Quinn, 1995) is a 55-item self-report measure of expected consequences of cigarette smoking. Respondents rate each item on a 0 ("completely unlikely") to 9 ("completely likely") scale to indicate the probability of occurrence of the consequence if she or he were to smoke a cigarette "right now". Indicators derived from the SCQ-A were item means from (a) the Health Risk subscale, (b) composite of negative expectancy subscales, and (c) composite of positive subscales.

2.2.5. Contemplation of quitting

The Contemplation Ladder (CL; Biener & Abrams, 1991) consists of a ladder with rungs labeled 1 to 10. The lowest score (0, below the bottom rung) represents "no thought of quitting", whereas the highest score (10) reflects "taking action to quit (e.g., cutting down, enrolling in a program)". In a worksite sample of smokers, CL scores significantly predicted subsequent attendance at an educational program about smoking and associated risks (Biener & Abrams, 1991).

2.2.6. Motivation to quit smoking

The Reasons For Quitting Scale (RFQ; Curry, Wagner, & Grothaus, 1990) presents a list of 20 reasons that smokers commonly would have to stop smoking. For each reason, participants rate on a scale from 0 to 4 how true that reason is for them currently. The 20 items comprise four subscales: Intrinsic-Health Concerns, Intrinsic-Self-Control, Extrinsic-Immediate Reinforcement, and Extrinsic-Social Pressure. For this study, we focused on the Intrinsic-Health Concerns subscale, which showed high internal consistency in our sample (alpha = .85).

2.2.7. Self-efficacy

The Smoking Self-Efficacy Questionnaire (SSEQ; Colletti, Supnick, & Payne, 1985) is a 17-item self-report measure of respondents' confidence that they could resist temptation to smoke in various high-risk situations. The respondent first indicates "yes" or "no" regarding whether abstaining would be possible, and (if "yes") gives a 10 to 100 rating of the degree of confidence, and we used the average item score as our self-efficacy indicator. SSEQ scores have been shown to predict length of time to first relapse after a smoking cessation attempt (Colletti et al., 1985). In our sample the SSEQ was highly internally consistent (alpha = .87).

2.2.8. Subjective response to imagery

The Imagery Response Form (Morissette, Palfai, Gulliver, Spiegel, & Barlow, 2005) was used to measure subjective responses to the guided imagery exercise. The first item assesses the extent to which the imagery sequences made the participant feel anxious, whereas the second item assesses the vividness of the imagery sequences by asking "How much did you feel like you were part of the imagery sequences?" Each was rated on a 1 ("Not at All") to 7 ("Extremely") scale.

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[1] Participants could smoke as little as 1 cigarette per day, though it turned out that the lowest reported figure was 3 per day. We set this low minimum smoking rate for eligibility (relative to some other studies that require, for instance, >=10 cigarettes/day) because even very light smoking (1 to 4 cigarettes/day) has been linked in longitudinal epidemiological research with death from heart disease and with all-cause mortality (Bjartveit & Tverdal, 2005). As such, practice guidelines (United States Department of Health and Human Services, May, 2008) recommend helping all tobacco users to quit.

2.3. Procedure

The study took place in two individual assessment sessions, one month apart. The first was an in-person experiment lasting about 1 h, in the following sequence:

(a) *Prior to the experimental manipulation*, participants completed at baseline the demographic and smoking (and cessation) history measures, the FTND, and the pretest state anxiety VAS.
(b) *Imagery manipulation*. After completion of the baseline measures, and a 90-second practice audiotape-guided imagery exercise that was the same for all participants, participants were randomly assigned (using a pre-selected random order generated via www.randomizer.org, with the participant's condition unknown to the experimenter until this point) to one of two conditions, differing in the content of the imagery exercises. The scenarios were presented back-to-back and read slowly by a male actor, allowing participants time to imagine the scenes depicted.

Looming vulnerability. Participants in this condition engaged in four audiotape-guided imagery exercises, each lasting about 3 min, in this order:

- Conveyor Belt[2]: This exercise places the participants in a dimly-lit factory, in which they are being carried along faster and faster on a conveyor belt as they smoke. This conveyor belt is described as ultimately leading to the diagnosis of lung cancer.
- Office Building: The second imagery exercise places participants in an office all alone, watching calendar pages fly off the wall. As participants smoke and time progresses, participants are meant to feel their lungs withering away and their heart beat becoming weaker and weaker.
- Train Tracks: The third imagery exercise is set in the open plains on top of a set of railroad tracks. As participants smoke, a train heading directly towards them gains speed.
- Clock Ticking: In this timing exercise, participants are instructed to imagine terrible health consequences related to smoking coming closer and closer to them as they smoke. In addition, participants are asked to keep track of time for a period of 3 min.

Each of these exercises refers to the act of smoking, relates smoking to negative health consequences, a common and appropriate fear of smokers, and incorporates a threat that is growing closer in time or space or both. The possibility of controlling the threat is mentioned for participants to consider (e.g., that reducing smoking rate would slow down the conveyor belt in the first scenario, but only eliminating smoking altogether would stop it). The core concepts for these scenes were suggested by Dr. John Riskind, developer of the looming vulnerability model. We altered them to incorporate specifics about smoking behavior, some of the particular health consequences, and the way in which participants could control the threat by stopping smoking. Also, feedback from practice subjects before the main study prompted us to lengthen the imagery exercises and to include more sensory references in order to make the imagery sequences more vivid.

Control condition. Participants assigned to this condition also engaged in four audiotape-guided imagery exercises designed specifically for this project, as follows:

- Escalator (parallel to "conveyor belt" above): This exercise takes place in an empty mall in the morning. The participants imagine they are slowly and steadily being carried by the escalator until they reach the top.
- Metro (parallel to "office building"): The second exercise involves riding public transportation while reading a magazine, steadily flipping the pages.
- Driving (parallel to "Train Tracks"): The third exercise involves driving a car. The car in this case moves steadily with no traffic hindrances that would cause a reduction of speed.
- Human Clock (parallel to "Clock Ticking"): The fourth exercise is another timing exercise. In this case, the participants receive instruction to pretend they are a human clock.

Imagery exercises in the Control condition incorporated elements of movement, whether it be movement in space or the progression of time, and they were matched for length of time and for sensory references to the looming vulnerability scenarios, but they contained no references to smoking or its consequences.

(c) *Post-imagery manipulation measures*. Immediately after completion of the guided imagery exercise, participants completed a post-test VAS state anxiety measure, the Imagery Response Form, and the measures of outcome expectancies (SCQ-A and SGO), self-efficacy (SSEQ), contemplation (CL), and motivation (RFQ).
(d) *Conclusion*. The experimenter then provided referral sources to address any anxiety that may have been caused by the experiment as well as referral sources for smoking cessation services. No active effort was made to persuade the participants to attempt to quit smoking, however. Finally, participants received twenty-five dollars as compensation for their time and made an appointment for a one-month follow-up phone interview.

2.3.1. One-month follow-up interview

At the one-month phone interview participants were re-administered the CL, the FTND, the SCQ-A health risk subscale, and the RFQ-Intrinsic-Health Concerns subscale. They were also asked about their smoking rate over the past month, whether they had made a 24-hour (minimum) quit attempt, and whether they had sought formal help or treatment to assist in quitting smoking.

2.4. Data analysis

Baseline descriptive data were calculated separately by experimental condition. The looming vulnerability and control conditions were compared via independent-groups *t* tests on the extent to which guided imagery made them feel anxious, on the vividness with which they experienced the imagery, and on post-induction contemplation, motivation, self-efficacy and the SCQ-A as a measure of outcome expectancies. Analyses of covariance (with pretest scores as the covariate) were used to test effects of the manipulation on state anxiety (immediate effects of the manipulation) and cigarette smoking rate (over the month after the experiment). Experimental condition effects on the categorical Self-Generated Outcome measure of highly accessible expectancies, initiation of a quit attempt in the following month, and seeking formal assistance in smoking cessation

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[2] As a sample, the complete script for the "conveyor belt" scenario follows: "Imagine that you are in a dimly-lit factory. As you look around you can see various machines in darkened corners. Suddenly you realize you are on a conveyor belt. You feel its rough texture beneath you. As you begin to smoke the conveyor belt begins to move. Faintly you hear the hum of the conveyor belt motor as it slowly carries you along. While you breathe in another puff of smoke, the conveyor belt moves faster. You realize the more you smoke the faster the conveyor belt becomes. You can now see that at the end of the conveyor belt are two paramedics holding a stretcher, waiting to take you away. The conveyor belt moves quicker and quicker as your cigarette becomes shorter and shorter. The realization that lung cancer lies at the end of the conveyor belt now dawns upon you. Your throat becomes dry from your gasp and from the smoke you take in as you approach your impending fate. You try to get off the conveyor belt, but it is moving too fast. The conveyor belt will slow down little by little if you smoke significantly less, but you cannot stop it unless you entirely stop smoking."

in the following month were evaluated via chi-squared tests. Effect sizes are reported for all statistical tests.

3. Results

3.1. Baseline equivalence of groups

Baseline data, separately by experimental condition, are reported in Table 1 for demographic variables and in Table 2 for smoking history, current smoking behavior, and nicotine dependence.

3.2. Vividness of imagery and effects on state anxiety

Immediate effects of the looming vulnerability induction are shown in Table 3. Participants rated the vividness of the imagery exercises fairly high (means over 5 on a 1 to 7 scale), and about equally across experimental conditions. Both the post-test in which participants were asked to report on how anxious the imagery exercise made them and the Visual Analogue Scale ratings of state anxiety showed significantly higher post-test anxiety among those in the looming condition, with effect sizes between "medium" and "large" per conventional standards (Cohen, 1988). An analysis of covariance on post-test VAS anxiety ratings, with pretest as the covariate and experimental condition as the independent variable, was also significant, $F(1, 69) = 9.61$, $p < .01$, partial eta squared $= .122$.

Table 1
Baseline group comparisons on demographics.

	Looming condition ($n = 36$)	Control condition ($n = 36$)
Age	46.19 (SD = 9.17)	47.06 (SD = 11.8)
Gender	50% Female	39% Female
Ethnicity: Hispanic or Latino (%)	3	3
Race		
American Indian	0	3
African American (%)	72	78
Caucasian (%)	11	19
Native Hawaiian/Pacific Islander (%)	3	0
Other (%)	14	0
Highest level of education		
Partial high school (%)	8	0
High school or GED (%)	39	47
Some college (%)	31	33
Technical school/associate's degree (%)	17	19
Bachelor's degree (%)	3	0
Graduate or professional degree (%)	3	0
Primary occupation		
Professional (%)	11	11
Manager/administrator (%)	6	14
Craftsman/kindred worker (%)	11	14
Clerical/sales worker (%)	39	17
Laborer/operative (%)	19	28
Student (%)	0	6
Other (%)	14	11
Current employment status		
Full-time (%)	33	33
Part-time (%)	17	14
Disabled (%)	17	6
Leave of absence (%)	3	3
Unemployed (%)	31	17
Retired (%)	0	3
Homemaker (%)	0	3
Annual household income		
Less than 10,000 (%)	39	28
10,000 to 19,999 (%)	17	6
20,000 to 29,999 (%)	14	47
30,000 to 39,999 (%)	0	0
40,000 to 49,999 (%)	14	6
50,000 to 74,999 (%)	11	14
75,000 to 99,999 (%)	6	0

Table 2
Baseline group comparisons on smoking, smoking history, and cessation history.

	Looming condition ($n = 36$)	Control condition ($n = 36$)
Years of daily smoking	26.25 (10.53)	27.97 (12.78)
Sought treatment to quit (%)	44	33
Attempt to quit (%)	67	53
Minimum number of cigarettes/day	8.25 (6.36)	7.64 (5.35)
Maximum number of cigarettes/day	19.53 (9.69)	21.92 (13.75)
Average number of cigarettes/day	12.57 (6.07)	13.18 (7.62)
Fagerstrom Test of Nicotine Dependence	4.22 (2.26)	5.06 (1.96)

Note: Figures are means except where noted (with Standard Deviations in parentheses).

3.3. Effects of looming vulnerability induction on contemplation and motivation to quit

Although participants in the looming condition reported higher mean scores on the Contemplation Ladder by about 1 point on the 0–10 scale, this difference was nonsignificant and small to medium in magnitude (see Table 3). Likewise, those in the looming condition obtained higher scores on the Intrinsic-Health Concerns subscale of the Reasons for Quitting measure of motivation, but again the group difference was nonsignificant and yielded a small-to-medium effect size (see Table 3).

3.4. Effects of looming vulnerability induction on self-efficacy and outcome expectancies

As reflected in Table 3, there was virtually no difference between conditions in positive expectancies for smoking measured with the SCQ-A ($d = .03$). Conversely, participants in the looming condition reported higher self-efficacy (SSEQ) and higher negative outcome expectancies for smoking (both with respect to the composite of all negative subscales of the SCQ-A and the Health Risk subscale in

Table 3
Immediate effects of looming manipulation.

Variable	Looming ($n = 36$)	Control ($n = 36$)	t (70)	p	d
State anxiety (VAS) pretest	24.67 (21.91)	23.81 (22.14)			
State anxiety (VAS) post-test	43.33 (28.65)	28.00 (20.36)	2.62	.01	.62
Imagery induced anxiety	3.33 (2.15)	2.25 (1.76)	2.34	.02	.55
Imagery vividness	5.36 (1.66)	5.08 (1.76)	0.69	.49	.16
Contemplation Ladder	6.61 (2.75)	5.67 (2.89)	1.42	.16	.33
Reasons For Quitting Intrinsic-Health Concerns item means (0–4)	2.84 (1.04)	2.44 (1.28)	1.46	.15	.34
SCQ-A outcome Expectancies Health Risk item means (0–9)	8.24 (1.10)	7.55 (2.06)	1.77	.08	.42
SCQ-A Negative composite	5.50 (1.54)	4.85 (1.72)	1.69	.09	.40
SCQ-A Positive composite	4.34 (1.55)	4.29 (1.39)	0.15	.88	.03
Self-efficacy	37.75 (24.25)	28.71 (18.45)	1.78	.08	.42

Note: Except where noted, numbers are group means, with standard deviations in parentheses. State Anxiety = Visual Analogue Scale (0–100). SCQ-A = Smoking Consequences Questionnaire-Adult. Negative composite = mean of negative expectancy subscales. Positive composite = mean of positive expectancy subscales. d = Cohen's d effect size measure [(Looming mean − Control mean)/pooled SD]. .2 = small, .5 = medium, .8 = large by convention.

particular) relative to those in the control condition. These effects were small to medium in size ($d = .40$ to $.42$) and marginal ($p = .08$ or $.09$).

On the Self-Generated Outcome measure of highly accessible outcome expectancies, there were significant group differences between conditions. No participants gave responses coded as "weight control". In the looming condition, 30 participants (83%) gave Negative Reinforcement responses, with the remainder evenly split between Positive Reinforcement (8%) and Negative Consequences (8%). In the control condition, 69% ($n = 25$) listed Negative Reinforcement responses, while the remaining 11 (31%) gave Positive Reinforcement responses. Including all categories in the analysis, the difference between conditions was significant, chi-squared ($df = 2$, $N = 72$) $= 8.03$, $p < .02$, phi $= .33$. Eliminating the weight control code and collapsing across Negative Reinforcement and Negative Consequences (the two codes associated with ever-smokers more so than never-smokers in McKee et al., 2003), those in the looming condition were significantly more likely to expect either negative consequences or negative reinforcement (91%, vs. 69% of control condition participants), chi-squared ($df = 1$, $N = 72$) $= 5.68$, $p < .02$, phi $= .28$.

3.5. Sustained effects of looming vulnerability induction on contemplation, motivation, and outcome expectancies

All one-month follow-up analyses were based on completers only ($n = 61$, 85% of the initial sample). Contemplation Ladder scores were quite similar to what had been observed in the initial assessment. Those in the looming condition ($n = 30$, $M = 6.80$, SD $= 3.10$) scored nonsignificantly higher than did those in the control condition ($n = 31$, $M = 5.77$, SD $= 2.92$), $t (59) = 1.33$, $p = .19$, $d = .34$. Follow-up scores on the RQS-Intrinsic-Health Concerns motivation measure also did not differ significantly by group ($M = 2.90$, SD $= 1.00$ for looming condition; $M = 2.60$, SD $= 1.25$ for control condition), $t (59) = 1.03$, $p > .3$, $d = .27$. Finally, the Health Risk subscale of the SCQ-A measure of outcome expectancies also yielded nonsignificantly higher scores at follow-up for the looming condition ($M = 7.99$, SD $= 1.39$) than for the control condition ($M = 7.30$, SD $= 2.51$), $t (59) = 1.33$, $p = .19$, $d = .34$.

3.6. Effects of looming vulnerability induction on smoking and quitting behavior

The FTND as a measure of nicotine dependence was repeated in the one-month follow-up phone call; participants in the looming condition averaged 3.30 (SD $= 1.88$), compared to 3.52 (SD $= 2.08$) for controls. An ANCOVA on these FTND scores, with baseline FTND as the covariate and experimental condition as the independent variable, was not significant, $F (1, 58) = 1.27$, $p > .4$, partial eta squared $= .010$.

Those in the looming condition did report smoking about 25% fewer cigarettes than did those in the control condition in the month after the experiment, however. The looming mean was 9.10 cigarettes per day (SD $= 6.72$), whereas the control mean was 12.90 (SD $= 9.02$). An ANCOVA on smoking rate, with baseline rate as the covariate and experimental condition as the independent variable, was significant, $F (1, 58) = 4.24$, $p < .05$, partial eta squared $= .068$.

Finally, Table 4 shows the frequency with which participants made a quit attempt of at least 24 h in the month after the experiment, as well as whether they sought formal assistance in attempting smoking cessation. For the association of experimental condition with a subsequent quit attempt, chi-squared ($df = 1$, $N = 61$) $= 2.43$, $p = .12$, phi $= .20$. The odds ratio was 2.60 (95% confidence interval $= 0.77$ to 8.82). If time 2 nonrespondents (6 in the looming condition, 5 in the control condition) are assumed not to have made a quit attempt, then the odds ratio for an intent-to-treat analysis would be 2.38 (95% CI $= 0.72$ to 7.86).

For the association of experimental condition with treatment seeking in the month after the experiment, chi-squared ($df = 1$, $N = 61$) $= 3.46$, $p = .06$, phi $= .24$. The odds ratio was 4.41 (95% confidence inter-

Table 4
Frequency of quit attempts and treatment seeking in the month after the experiment.

	Yes	No	% Yes	Chi-squared ($df = 1$, $N = 61$)	p	Odds ratio
Quit attempt						
Looming	10	20	33	2.43	.12	2.60
Control	5	26	16			
Treatment seeking						
Looming	7	23	23	3.46	.06	4.41
Control	2	29	6			

val $= 0.93$ to 20.35). If time 2 nonrespondents are assumed not to have sought treatment, then the odds ratio for an intent-to-treat analysis would be 4.10 (95% CI $= 0.88$ to 18.63).

4. Discussion

In this pilot study, a guided imagery manipulation was developed with the aim of increasing smokers' sense of "looming vulnerability" to the negative health consequences of cigarette smoking. Extrapolating from basic research on anxiety and anxiety disorders by Riskind and colleagues (e.g., Riskind et al., 2006), we hypothesize that perceiving the threat posed by these negative consequences of smoking to be rapidly escalating and coming closer to the participant in space and time would increase anxiety and, in turn, alter outcome expectancies for smoking and increase contemplation of and motivation for smoking cessation. Our hope was that these effects could be obtained without decreasing participants' self-efficacy to abstain from smoking. Most importantly, the looming vulnerability induction was intended to increase the likelihood of a smoking cessation attempt.

We consider the results of this preliminary study encouraging, albeit certainly not definitive. The looming vulnerability imagery manipulation significantly increased state anxiety and altered highly accessible outcome expectancies for smoking among daily smokers. Small to moderate, though nonsignificant, effects were observed, consistently in the hypothesized direction, for increasing contemplation of smoking cessation, negative outcome expectancies for smoking, and intrinsic motivation to quit as a function of health concerns, through one-month follow-up. The looming induction not only did not decrease self-efficacy; self-efficacy was marginally *higher* in the looming rather than in the control condition, suggesting that our inclusion in the imagery scripts of ways in which the participant could slow or stop the looming threat (i.e., by eliminating smoking) was helpful. Participants in the looming condition reported significantly greater decreases in smoking rate over the month after the experiment. Finally, we are particularly encouraged by the nonsignificant trends indicating that those in the looming condition were more likely to seek formal help for smoking cessation (odds ratio $= 4.41$) and to make a serious quit attempt (odds ratio $= 2.60$).

We consider these findings noteworthy especially because one might expect any intervention that increases anxiety to *increase* smoking rate. Anxiety is associated with cravings to smoke (Tiffany & Drobes, 1990), and anxiety disorders have been linked with higher prevalence of smoking (Morissette, Tull, Gulliver, Kamholz, & Zimering, 2007). Our preliminary data are contrary to this typical linkage in that the looming induction increased anxiety but lowered the smoking rate, presumably because the source of the increased anxiety was not the stressors of daily life but rather an intervention aimed at activating the sense that negative consequences of smoking are becoming more immediate and proximal.

These promising preliminary results notwithstanding, the study had a number of limitations that should be addressed in future research. First, the looming vulnerability imagery scenarios were the first ones we tried, and while vividness ratings were high on the

whole, we have no way of knowing whether each script is as strong a manipulation as possible. Second, the one-month follow-up assessment was conducted via telephone, and it would be preferable in future research to conduct all assessments in person. Third, to limit practice effects, measures of contemplation, motivation, and expectancies were completed only after the experimental manipulation, rather than pre- and post-test. Thus, we can compare the looming and control conditions but cannot directly estimate changes from before to after the looming manipulation on these variables. Fourth, all assessments were conducted via self-report. From the standpoint of limiting the potential effects of demand characteristics, it would be preferable to supplement self-reports with measures of physiological indicators of anxiety in response to the looming manipulation and with biochemical measures capable of corroborating changes in smoking rate or successful quit attempts. Fifth, sample size was modest, constraining statistical power. Power was satisfactory by convention (.80) only for detecting medium-to-large effects ($d = .67$ or greater). Sixth, in order to measure the effects of the looming vulnerability induction in isolation, participants were not given explicit advice to quit and were not directed to any resources they might use in trying to do so. Future research should examine whether effects on quit attempts could be enhanced by providing such advice and materials.

5. Conclusions

Results of this pilot study suggest that further refinement and larger-scale empirical study of the looming vulnerability induction for smokers are warranted. If effects on state anxiety, highly accessible outcome expectancies, and smoking rate can be replicated, and if nonsignificant trends relating to self-efficacy, negative outcome expectancies, and quit attempts are confirmed in larger studies, then several directions for follow-up work would be evident. First, research could address the generality of these effects across different types of samples. Our sample was mainly African American (75%) and included a range of smoking rates, but with the average being fairly light (about 13 cigarettes per day). It would be useful to determine the effects of looming vulnerability inductions with heavier smokers and with other races/ethnicities. Second, experiments could be conducted in which the looming vulnerability manipulation is contrasted with increasingly stringent control scenarios (e.g., scenarios involving a threat that is not looming; or a threat that is not related to consequences of cigarette smoking) in order to evaluate specificity of effects. Third, it would be valuable to conduct experiments comparing the effect on quit attempts and contemplation of looming vulnerability manipulation relative to expectancy challenge (e.g., Copeland & Brandon, 2000), values self-confrontation (e.g., Grube, Mayton, & Ball-Rokeach, 1994), or to motivational interviewing, recommended by current practice guidelines (United States Department of Health and Human Services, 2008) as an option for smokers currently unwilling to quit.

Fourth, it would make sense to conduct longer-term studies to determine the time course of effects on quit attempts and to determine the long-term success of the quit attempts that follow from looming vulnerability manipulations. Fifth, it would be valuable to test dose effects and medium effects. For example, video could be compared with imagery as a means of activating looming vulnerability, or multiple sessions with one session, or online versions of the induction with in-person delivery by an experimenter. Finally, if research consistently shows significant increases in quit attempts, then dissemination studies would be valuable. Studies could test the efficacy and cost-effectiveness of efforts to disseminate looming vulnerability manipulations via web-based self-help, physician advice, community health organizations, dentists' offices, public service announcements, high school health classes, and so on.

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