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Original Investigation

The effect of smoking cues in antismoking advertisements on smoking urge and psychophysiological reactions

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Abstract

Introduction: Studies have found that smoking-related cues elicit smoking urges in addicted smokers. This work presents the first cue-reactivity study in the context of antismoking advertisements.

Methods: Using a two (no cue vs. smoking cue) by two (high vs. low argument strength) mixed design, we tested the hypothesis that smoking cues presented in antismoking advertisements elicit smoking urges. The study tested 96 adult smokers using both self-reported and psychophysiological measures of smoking urge. It also explored gender differences during the urge elicitation.

Results: Smoking cues in antismoking advertisements elicited smoking urges in the weak argument condition.

Discussion: Antismoking advertisements with smoking cues and weak antismoking arguments could produce boomerang effects on smokers through urge elicitation.

Introduction

An important factor that contributes to relapse in smokers is how current and former smokers respond to smoking-related cues. Besides direct personal experience, mass media constitutes a major source of smoking-related cues. Examples of such media include magazine advertisements for cigarettes and celebrity smoking in movies. Antismoking advertisements represent another venue for smoking-related cues, although they use smoking cues to illustrate the negative consequences of smoking as part of the antismoking arguments. Based on our preliminary review of 99 antismoking advertisements that lasted 30 s each, targeted adult smokers, and were focused on cessation and treatment seeking, more than one-third of the advertisements contained smoking cues. However, to the best of our knowledge, no cue–reactivity studies have examined antismoking advertisements.

Our first goal was to test the hypothesis that smoking cues presented in the context of antismoking advertisements elicit smoking urges. If this is the case, smoking urges could counter the persuasive intent of the advertisements and undermine their effectiveness. Our second goal was to examine the role of the advertisements' argument strength. By "argument" we mean the implicit and explicit reasons given in the advertisement for not smoking cigarettes or using tobacco. Arguments can be an influential factor in persuasive success during message processing, particularly in groups who are able and motivated to respond to the message (Petty & Cacioppo, 1986). Studies have suggested an interactive relationship between argument strength and other message features (e.g., message sensation value; Kang, Cappella, & Fishbein, 2006) or audience characteristics (e.g., risk of marijuana use; Kang, Cappella, & Fishbein, in press) on younger audiences' evaluations of message effectiveness in discouraging drug use. In the present study, we crossed argument strength with smoking cues to evaluate the contingent effects of smoking cues on advertisement reactions depending on the advertisement argument strength.

Cue-elicited smoking urge

A smoking cue is defined here as a visual cue that presents at least one of the following: (a) smoking-related materials (i.e., cigarettes, ashtrays, matches, lighter, and the like), (b) holding and handling of a cigarette without smoking it, and (c) actual smoking of a cigarette. These cues have been used in prior cue-reactivity studies and elicited smoking urges in adult smokers (e.g., Hutchison, Niaura, & Swift, 1999; Tiffany, Carter, & Singleton, 2000; Waters et al., 2004).

Cue-reactivity studies often assess smoking urges using both psychophysiological and self-reported measures (Niaura et al.,

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1988). Both types of measures have been linked to relapse for at least some smokers (Rohsenow, Niaura, Childress, Abrams, & Monti, 1990; Shiffman, 1986). The present study assessed both psychophysiological responses (heart rate and skin conductance) and self-reported smoking urges. Whereas psychophysiological responses provide the biological roots of smoking urges, self-reported measures show that the smokers actually report experiencing smoking urges.

Based on previous evidence on cue-elicited smoking urges, we posed the first hypothesis: that smoking cues in the antismoking advertisements increase self-reported smoking urges. Antismoking advertisements seek to create more negative attitudes toward smoking and more favorable intentions toward quitting. The antismoking arguments of the advertisements might counteract the potential negative effects of smoking cues when they are present (i.e., eliciting smoking urge and subsequent smoking behavior). However, this assumption has not been tested explicitly. Persuasion studies generally found stronger arguments to be more effective than weaker ones, at least for able and motivated audiences (Petty & Cacioppo, 1986). In the context of antismoking advertisements, stronger antismoking arguments might suppress smoking urges in the presence of smoking cues more than weaker arguments do. However, smoking urges might be difficult to control in the face of smoking cues regardless of the strength of antismoking arguments. Because no studies have examined the impact of argument strength on cue-elicited urges, we asked only a research question here: Can stronger arguments in antismoking advertisements better counteract cue-elicited smoking urges than weaker arguments?

Psychophysiological reactions during urge elicitation

Psychophysiological responses to smoking cues during urge elicitation have been explained through withdrawal or approach models (Carter & Tiffany, 1999). Both models consider urges as subjective motivational states that are associated with either withdrawal or approach effects of drugs influenced by negative or positive outcome expectancies (Tiffany, 1990). Smoking cues and antismoking arguments in antismoking advertisements provide both a withdrawal agent (i.e., antismoking arguments emphasizing negative outcome expectancies of smoking) and an approach agent (i.e., smoking cues showing positive outcome expectancies of smoking) for urge elicitation and, therefore, may be guided by either withdrawal- or approach-based models.

Specifically, withdrawal-based models predict that drug cues will elicit cue responses that are physiologically withdrawal like (or opposite to direct drug effects; Poulos, Hinson, & Siegel, 1981; Wikler, 1948). Withdrawal is often manifested through a decrease in heart rate and skin conductance during drug cue exposure (Carter & Tiffany, 1999; Niaura et al., 1988). These withdrawal-like psychophysiological reactions may be influenced by the outcome expectancy of not being able to smoke. In the context of antismoking advertisements, the antismoking arguments seeking to move smokers away from smoking may set this negative expectancy while the smoking cues may set the positive expectancy of smoking. The withdrawal-based model hence would explain the case where the withdrawal effect induced by antismoking arguments is stronger than the approach effect from the cue-elicited urge.

Approach-based models, by contrast, consider urges as representing positive-affective motivational states (Stewart, de Wit, & Eikelboom, 1984): memories for positive-reinforcing effects of drugs (Wise, 1988), anticipation of drug euphoria (McAuliffe & Gordon, 1974), expectancies of drug-related positive outcomes (Marlatt, 1985), and incentive salience of stimuli associated with drug use (Robinson & Berridge, 1993). Approach-based models hence predict that urge elicitation should be paired with physiological responses that are similar to drug effects that are positive in valence. Meta-analysis of cue-reactivity studies of Carter and Tiffany (1999) suggests that approach-based models generally reveal increased heart rate and skin conductance during urge elicitation (Niaura et al., 1988). In the context of antismoking advertisements, an approach-based model would explain the condition in which the approach effect from the cue-elicited urge is stronger than the withdrawal effect from antismoking arguments.

In their meta-analysis testing the withdrawal- and approach-based models, Carter and Tiffany (1999) calculated effect sizes for both self-reported craving and psychophysiological responses of smokers to smoking cues versus neutral stimuli. For cigarette smokers, the average effect sizes (d) of smoking cues were as follows: on heart rate, 0.21 (95% CI = 0.07–0.34, k = 8); on skin conductance, 0.44 (95% CI = 0.31–0.59, k = 7); and on self-reported craving, 1.18 (95% CI = 1.05–1.31, k = 10). These data show more support for the approach-based model than for the withdrawal-based model in the context of traditional cue-reactivity studies (without antismoking arguments as a withdrawal agent). Based on these findings and an assumption that antismoking advertisements are similar to the stimuli used in traditional cue-reactivity studies, we posed the second hypothesis: that smoking cues in the antismoking advertisements increase heart rate and skin conductance.

If advertisements with stronger arguments are better at counteracting cue-elicited smoking urges than are advertisements with weaker arguments, smoking cues should elicit greater psychophysiological reactions in advertisements with weaker than stronger antismoking arguments. Due to lack of evidence on the effects of argument strength on cue reactivity, again we asked only a research question here: Is the impact of smoking cues on psychophysiological responses stronger for advertisements with weaker antismoking arguments than for those with stronger antismoking arguments?

Gender differences in cue reactivity

Significant gender differences have been found in previous cue-reactivity studies. Self-reported urges after cue exposure increased more in female smokers than in male smokers (Shiffman et al., 2003), and the increases in self-reported smoking urges after exposure to smoking cues (vs. control stimuli) were significant only in female smokers (Field & Duka, 2004). Men had larger heart rate increases after exposure to certain smoking cues (i.e., upset script, personal high-risk situation, and recent relapse script) compared with women smokers (Niaura et al., 1998). Although these studies support gender differences in smoking cue reactivity, the data are inconsistent with regard to which gender responds more

intensely to smoking cues. Thus, in the present study we also explored gender differences in self-reported urges and psychophysiological responses.

Methods

Experimental design

The study had a two-argument strength (high vs. low, between-subject factor) by two-smoking cue (presence vs. absence, within-subject factor) mixed design. Six advertisements were presented in each argument condition, with three no-cue advertisements followed by three smoking cue advertisements. Using smoking cue exposure as a within-subject factor is consistent with previous studies (e.g., McDermut & Haaga, 1998; M. J. Morgan, Davies, & Willner, 1999; Shadel & Cervone, 2006). In addition, presenting no-cue advertisements before smoking cue advertisements reduces the possibility that smoking urges elicited by smoking cues would be carried over to the no-cue advertisements and contaminate the smoking cue effects (Erblich & Bovbjerg, 2004; Richard-Figueroa & Zeichner, 1985). However, this unbalanced presentation order introduced a confounding between cue presentation and time. Because baseline information was collected for the psychophysiological measures before each advertisement presentation and smoking cue effects were tested using change scores over baseline, we expect the confounding to be less an issue for the psychophysiological measures. The advertisement presentation order within each argument by cue condition was randomized for each participant to control for the order effect.

Advertisement stimuli

A total of 12 advertisements (6 in each argument strength condition) were selected from our advertisement archive. Each advertisement met five criteria: 30 s in length, in English, not targeting second-hand smoking, targeting adults, and focusing on cessation and treatment seeking. Only advertisements showing smoking behaviors (including holding, handling, and actual smoking) from human beings (not animated characters) were included in the smoking cue category. Only one advertisement (in the strong argument and smoking cue condition) showed a burning cigarette without human figures presented. Although not an actual smoking behavior, this type of cue was found to elicit smoking urges (Sayette & Hufford, 1994).

The argument strength of these 12 advertisements was evaluated in a previous study (X. Zhao et al., manuscript under review). In that study, one comprehensive argument for each advertisement was extracted by the research team covering all the individual arguments (both visual and verbal) presented in the advertisement. A total of 300 adult smokers recruited via shopping mall intercept (50% male, 74% White, mean age = 37 years [SD = 13]) evaluated the extent to which each antismoking argument was "strong," "believable," "important," "made them feel confident to quit smoking," "kept their friends from smoking," "elicited agreement from them," and "put thoughts in their mind about staying away from smoking." These seven judgments were measured on five-point scales (1 = strongly disagree, 5 = strongly agree). Among the 99 antismoking advertisements evaluated (argument strength score ranging from 20.5 to 32.1), 12 advertisements were selected into either the high or the low argument strength condition based on their summative scores on the seven items: M_{weak} = 25. 6, SD = 0.8 vs. M_{strong} = 30.7, SD = 1.2, $t(10) = 8.8$, $p < .001$ (X. Zhao et al., manuscript under review). Because of extensive evaluations in the previous study, no evaluation of argument strength was collected in this experiment. The Appendix shows the arguments of the 12 advertisements and the corresponding argument strength scores.

Experimental procedures

Participants were recruited through Craig's List and street flyers posted around western and central Philadelphia, PA. Recruited individuals were told they would watch antismoking advertisements and their opinions and physiological reactions would be collected. They were screened to be regular smokers between 18 and 65 years of age, smoking at least 10 cigarettes per day for at least 6 months, and not currently undergoing treatment for smoking cessation. Compensation for participation and transportation was provided. To standardize exposure to nicotine and tobacco and reduce urges related to nicotine deprivation (e.g., Upadhyaya, Drobes, & Wang, 2006), eligible participants were asked to smoke a cigarette right before participation (Bordnick, Graap, Copp, Brooks, & Ferrer, 2005).

Participants arrived at the laboratory between 9 a.m. and 6 p.m. on weekdays. They were randomly assigned to either the strong or the weak argument condition. In each condition, after baseline questions (including demographics, smoking history, and baseline smoking urge) were answered, sensors were attached to the participant to collect skin conductance and heart rate data during advertisement viewing. Participants watched three no-cue advertisements without answering any questions between or during the advertisements. Each advertisement-viewing session had a 30-s to 45-s baseline time with blank screens before each advertisement started. After viewing the advertisements, participants completed the outcome measures including smoking urge and other attitudinal variables not analyzed in the present study. Psychophysiological responses were not collected while questions were answered. After participants finished this set of outcome measures and right before they watched smoking cue advertisements, their baseline smoking urge for smoking cue advertisements was measured. They then watched three smoking cue advertisements. The same psychophysiological data were recorded. After this advertisement-viewing period, all sensors were detached from the participants and the same set of outcome measures was collected.

Participants

Data on four participants were excluded because sensors fell off two participants and the other two participants fell asleep during the study. A total of 96 participants finished the study. Mean participant age was 33 years (SD = 12); 54% were male. The majority of the participants were White (59%), followed by Black (24%), Hispanic (5%), and Asian (4%). On average, they smoked their first cigarette at the age of 15 (SD = 4), and smoked an average of 17 cigarettes per day (SD = 9) during the week prior to the study.

Measures

Smoking urge was measured with a five-item brief form of the Questionnaire of Smoking Urges (Cox, Tiffany, & Christen, 2001). The scale items ranged from strongly disagree (1) to strongly agree (7) (actual data ranging from 1.6 to 6.8). Smoking urge was assessed four times in the study with high reliability (Cronbach's $\alpha = .84–.90$).

The psychophysiological measures were collected with Biopac software. A difference score was calculated for each advertisement by subtracting 30-s baseline means from the corresponding advertisement viewing means for heart rate and skin conductance responses. This was done to adjust initial individual differences and to remove prestimulus influences (e.g., Fridlund & Cacioppo, 1986; Niaura et al., 1998; Waters et al., 2004).

Data analyses

The hypotheses and research questions were first tested using repeated measures analyses of variance (ANOVAs) with smoking cue as the within-subject factor and argument strength (manipulated to be low vs. high, not evaluated during the study) as the between-subject factor. Gender was then added as a potential moderator in the second set of repeated measures ANOVAs.

Results

We found no significant differences between participants in the two argument conditions in any demographic, individual differences, or smoking behaviors assessed in the study; none of these variables were controlled in subsequent analyses.

Simple hypothesis tests

Smoking urges. A significant quadratic main effect of smoking cue, $F(1, 94) = 4.2$, $p < .05$, partial $\eta^2 = .04$, and a marginally significant linear interaction between smoking cue and argument strength, $F(1, 94) = 3.8$, $p = .06$, partial $\eta^2 = .04$, were found on smoking urges. The results are graphed in Figure 1. Smoking urges started at a relatively high level for smokers in both argument conditions ($M = 3.4$, $SD = 1.2$). Urges decreased after participants watched the no-cue advertisements ($M = 3.3$, $SD = 1.3$) and increased slightly after they watched smoking cue advertisements ($M = 3.4$, $SD = 1.4$), which produced a significant quadratic effect. The linear interaction resulted from the smoking urge after watching smoking cue advertisements. Whereas smokers in the weak argument condition significantly increased their smoking urge after watching smoking cue advertisements, $M_{\text{pre cue}} = 3.3$, $SD_{\text{pre cue}} = 1.3$ vs. $M_{\text{post cue}} = 3.5$, $SD_{\text{post cue}} = 1.4$, $t(47) = 2.6$, $p = .01$, smokers in the strong argument condition did not, $M_{\text{pre cue}} = 3.3$, $SD_{\text{pre cue}} = 1.3$ vs. $M_{\text{post cue}} = 3.2$, $SD_{\text{post cue}} = 1.5$. Thus, smoking cues increased smoking urges only for advertisements with weaker arguments.

Heart rate. Smoking cue had a significant main effect on heart rate change (measured in beats per minute). Advertisements with smoking cues were associated with a larger heart rate reduction ($M = –1.2$, $SD = 1.9$) than advertisements without smoking cues ($M = –0.4$, $SD = 1.6$), $F(1, 88) = 14.4$, $p < .001$, partial $\eta^2 = .14$. Argument strength interacted with smoking cues on heart rate change, $F(1, 88) = 6.1$, $p < .02$, partial $\eta^2 = .07$, such that the difference in heart rate change between no-cue and smoking cue advertisements was significant only for advertisements with weaker arguments, $M_{\text{no cue}} = –0.3$, $SD_{\text{no cue}} = 1.5$ vs. $M_{\text{cue}} = –1.5$, $SD_{\text{cue}} = 2.1$, $t(44) = 4.5$, $p < .001$. The magnitude of the heart rate change is consistent with previous literature (Carter & Tiffany 1999; Kelly, Barrett, Pihl, & Dagher, 2004). Figure 2 presents the results. This finding, paired with the finding that smoking cues elicited stronger smoking urges in the weak argument condition, suggests that stronger urges might be associated with a reduction in heart rate.

Skin conductance. We did not find any significant main or interaction effects on skin conductance.

Summary. Our findings did not support the second hypothesis, according to the approach-based model. Instead, it revealed that smoking cues reduced heart rate in the weak argument condition, which was the same condition in which smoking cues had the strongest impact on smoking urges.

Gender differences

An overall urge change score was calculated as the difference between urge change during viewing no-cue advertisements and urge change during viewing smoking cue advertisements. A marginally significant effect for this urge change was obtained, $F(1, 92) = 3.7$, $p < .06$, partial $\eta^2 = .04$, along with a main effect for gender, $F(1, 92) = 7.0$, $p < .01$, partial $\eta^2 = .07$, and a significant interaction between gender and smoking cue, $F(1, 92) = 5.0$, $p < .03$, partial $\eta^2 = .05$. Smoking cues significantly increased urge change only in male smokers, $M_{\text{no cue}} = –0.4$, $SD_{\text{no cue}} = 0.8$ vs. $M_{\text{smk cue}} = 0.1$, $SD_{\text{smk cue}} = 0.7$, $t(51) = 3.1$, $p = .003$. Figure 3 presents the interaction.

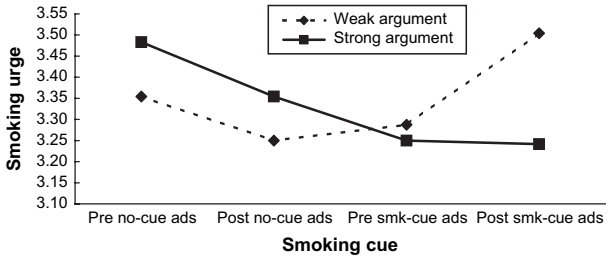

Figure 1. Interaction between argument strength and smoking cue on smoking urge ($p < .06$).

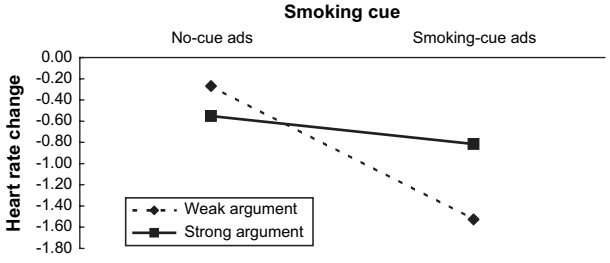

Figure 2. Interaction between argument strength and smoking cue on heart rate change scores ($p < .02$).

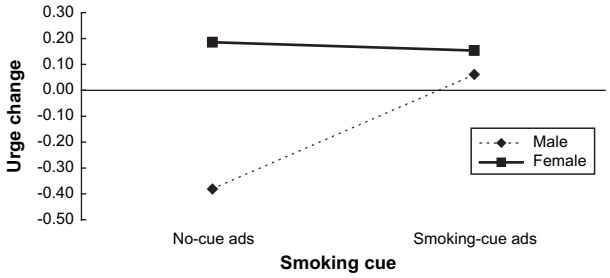

Figure 3. Gender moderates the impact of smoking cues on smoking urge changes ($p < .03$).

Gender interacted with smoking cues on skin conductance change over baseline, $F(1, 82) = 4.7$, $p < .05$, partial $\eta^2 = .05$. This effect was due primarily to the decreases in skin conductance for men, although the effect was not significant. Male smokers experienced a larger decrease in skin conductance during viewing smoking cue advertisements, $M = –0.4$, $SD = 0.9$, compared with viewing no-cue advertisements, $M = –0.1$, $SD = 0.7$, $t(48) = 1.8$, $p < .08$, whereas female smokers' skin conductance reduction was not significantly different while viewing no-cue advertisements, $M = –0.3$, $SD = 0.6$, and smoking cue advertisements, $M = –0.2$, $SD = 0.8$.

Gender did not affect participants' heart rate change during advertisement viewing.

Discussion

We tested adult smokers' cue reactivity (cue-elicited smoking urges and psychophysiological responses) to smoking cues presented in antismoking advertisements. Smoking cues in the antismoking advertisements appeared to increase smoking urges and reduce heart rate in response to weak arguments. This finding suggests that smoking urge may be paired with a reduction rather than an increase in heart rate, reflecting the possibility of an increased orienting response. In addition, the finding that male smokers who reported the strongest cue-elicited urges also exhibit a weak pattern of reduced skin conductance in response to those cues provides suggestive evidence that elevated smoking urges in response to smoking cues in antismoking advertisements may be linked to reduced skin conductance. Although our results do not fully support the withdrawal-based model, in the current context they are more consistent with this model than the approach-based model.

Why not the approach-based model?

The present study's lack of support for the approach-based model has two possible reasons. The first reason has to do with the generalizability of the meta-analysis cited in the introduction (Carter & Tiffany, 1999). The number of studies in the meta-analysis is small ($N = 10$). Only one study used video format to present smoking cues, which is the format used in the present study. Second, all studies included in this meta-analysis completely or partially counterbalanced the order of the smoking cue versus the neutral cue. However, concerns over carryover effects (Rohsenow & Niaura, 1999) led us to use one presentation order—no-cue advertisements followed by smoking cue advertisements. Third, the meta-analysis shows inconsistent effect sizes for skin conductance and craving (with a significant Q statistic), suggesting considerable variation across the studies. The present study may represent an infrequent condition or one that is outside the frame of the meta-analysis. Fourth, no previous cue-reactivity studies have been done in the context of antismoking advertisements. In sum, the original meta-analysis on which we based our hypotheses may not apply to the antismoking advertisements. However, due to the lack of direct evidence from studies using antismoking advertisements as stimuli or conducted in a similar context, we cannot conclude that the effects found here point to the withdrawal-based model as most applicable in the context of antismoking advertisements. Replications using similar stimuli will improve the validity of this claim.

The second reason has to do with the nature of the antismoking advertisements. Our study presented smoking cues in the context of arguments and images against smoking. Smoking urge as well as psychophysiological reactions during urge elicitation are affected not only by smoking cues but also by the antismoking arguments. In our study, advertisements with only antismoking arguments and no smoking cues exhibited a trend to reduce smoking urge over the preadvertisement baseline. The counterattitudinal factor (antismoking arguments) may put smokers' cue reactivity in a negatively valenced state (e.g., feeling anxious, sad, or hopeless about their smoking desire in face of the antismoking tone of the advertisements), which may affect the motivational valence of the smoking cue and make the psychophysiological reactions withdrawal like. Thus, the conflict between the nature of the message (antismoking) and the status of the message receiver (regular smokers without treatment for quitting smoking) may explain why an approach-based model that considers smoking urge as a positive motivational state may not fit in such a context.

Limitations and future directions

The present study tested existing antismoking advertisements. Since no antismoking campaign would use extremely weak arguments as interventions, this study contrasts advertisements with less strong and stronger arguments instead of those with weak and strong arguments. Despite the small difference between the weaker and stronger arguments in our study, the data exhibit significant interactions between argument strength and smoking cues on some measures. The use of actual antismoking advertisements allows us to better understand the effects of existing advertisements and to make practical suggestions based on real messages.

Although efforts have been made to pretest and select experimental advertisements as comparable as possible between conditions, the advertisements still may vary along innumerable dimensions. These unmeasured components could explain the study's outcomes. To minimize (but certainly not remove) these concerns, we used multiple advertisements in each condition to cancel the potential effects from unmeasured confounders. Future studies should test the same hypotheses with more controlled comparisons or a broader set of advertisements.

Because smoking cue advertisements were presented after no-cue advertisements, smoking cue exposure was confounded

with time. Participants might feel stronger urges at the end of the study simply because of the elapsed time without smoking. However, several factors mitigated this possible effect. First, baseline smoking urge was collected before presentation of both no-cue and smoking cue advertisements. Smoking cue effects were tested on changes over baseline rather than on end-of-presentation urges. Second, on average, participants reported the same level of smoking urge at the outset and after the experiment, suggesting little time effect. Only participants in the weak argument condition reported stronger urges at the end of the experiment, which suggests an argument strength effect rather than a time effect. Finally, some researchers argue that cue reactivity may be stronger to cues presented earlier than later; hence, researchers should present cues later in the sequence to avoid inflating the effects (McCusker & Brown, 1991).

Because we did not use a control group, we cannot compare whether the effects of smoking cues on self-reported urges and psychophysiological responses to antismoking advertisements are different from those in response to other types of audiovisual messages, and whether anxiety plays a role in the effects under such an experimental setting. Future studies with a control group that watches nonsmoking-related advertisements may help disentangle this problem.

Implications for advertisement design

The present study suggests that adult smokers' smoking urges increase after exposure to smoking cues in antismoking advertisements when the advertisements contain weaker arguments. The finding has two major implications for advertisement design with outcomes that could have an important health impact. First, the results highlight the possibility of urge elicitation when using smoking cues in antismoking advertisements. When antismoking advertisements are designed to target heavy or addicted smokers, for whom smoking urges are a legitimate concern, it may be worth reconsidering the inclusion of smoking cues in the advertisements to avoid boomerang effects. Second, these data highlight the importance of the strength of antismoking arguments. Strong arguments appear to counteract the urges elicited from smoking cues. Without strong antismoking arguments, smoking urges may surface and potentially lead to reactions counteractive to the antismoking intention of the message. Preliminary evidence indicates that cue-elicited smoking urges may be positively related to involvement with smoking, which contributes to lower level of quitting intention in adult smokers (Kang, 2007). However, because of the potential confound between cue exposure and repeated measurements, it is not clear whether the results reflect the cue effect or a testing effect.

Even without the concern about smoking cues, argument strength is a major factor affecting antismoking advertisement effectiveness. For example, tobacco company–sponsored antismoking advertisements that provided no strong argument for staying away from smoking actually increased youths' intention to smoke (Wakefield et al., 2006). Thus, from an advertisement production perspective, testing antismoking arguments before embedding them in the advertisements is a necessary step to eliminate potentially weak arguments. In sum, when uncertainty exists about urge elicitation, an antismoking advertisement may either stay away from the smoking cues to avoid potential risk of eliciting smoking urges from the most vulnerable smokers or use pretested strong antismoking arguments to counteract the potential impact of smoking cues.

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Declaration of Interests

This paper is based on the first author's doctoral dissertation work conducted at the University of Pennsylvania. The authors have no competing interests.

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Appendix. Arguments of the experimental advertisements and associated argument strength scores

Condition	Advertisement name	Argument	Argument strength
No-cue weak argument	Breath test	Smoking causes very bad breath, which cannot be covered with mints. Most people do not like to kiss smokers.	26.8
	Darrin Steele	Putting fire and smoke near your mouth is not natural. But once people begin smoking, they cannot quit. Smoking is not cool. What is cool is not to start smoking, so that you reach your full potential.	25.9
	Simple things	Quitting smoking is difficult, particularly for those who have busy lives. But there are simple things that you can do that will help.	25.3
Smoking cue weak argument	Outside the bar	People do not want to be around smokers. Women do not find it attractive. Quit to avoid public disapproval.	24.5
	In your mouth	Cigarettes are disgusting. Why would you want to put cigarettes in your mouth?	25.4
	Toilet-Chuck	You associate many places and activities with smoking, such as eating, drinking, and talking on the phone. If you try to quit, be aware of the things associated with smoking.	25.4
No-cue strong argument	Conspiracy cinema	Cigarette smoking causes 3 million deaths annually. The tobacco industry does not care about the deaths it causes.	29.0
	Scuba	By quitting smoking, you will be able to breathe more easily and to enjoy many new sports and activities.	30.5
	Iron cross	If you quit smoking, you decrease your infant's risks of asthma, bronchitis, and pneumonia. You also increase their chances of being healthy and strong.	31.7
Smoking cue strong argument	Chain	When kids see their parents smoke, they are more likely to try smoking, too. When you smoke, your family smokes, too.	29.5
	Cigarette with pills	Smoking causes emphysema. Emphysema has no cure, only a long, painful life filled with taking many medicines, and eventually death.	31.8
	Incredible journey	When you smoke while you are pregnant, you are delivering cigarette smoke to your unborn baby.	31.5