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Original Investigation

Experimental evaluation of antitobacco PSAs: Effects of message content and format on physiological and behavioral outcomes

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Abstract

Introduction: Antitobacco media campaigns using public service announcements (PSAs) have shown promise in reducing smoking initiation and increasing intentions to quit. Research on what makes an effective PSA has had mixed outcomes. The present study tested the effects of specific message features in antitobacco PSAs, using theory-based physiological and self-report outcomes.

Methods: PSAs were categorized as high or low in message sensation value (MSV) and strength of argument and presented to 200 current smokers in a 2×2 factorial design. Physiological responses—specifically, heart rate, skin conductance, zygomaticus major, and corrugator supercilii—were assessed while participants viewed the PSAs. Beliefs, attitudes, efficacy, norms, and intentions to quit were assessed immediately following viewing.

Results: Corrugator activity was significantly greater in the high MSV condition. Among those low in sensation seeking, low MSV PSAs elicited higher self-efficacy, whereas the reverse was true for high sensation seekers. High MSV PSAs elicited higher negative beliefs in low sensation seekers. Adding physiological measures to a model predicting intention to quit did not improve the explained variance.

Discussion: The present study represents the first comprehensive theory-based experimental investigation of the effects of different features of antitobacco PSAs and provides a framework for future research in identifying effective features of such PSAs. Results illustrate the importance of considering individual differences, characterizing both PSA content and format, and outcome and response measures when evaluating antitobacco PSAs.

Introduction

Smokers are exposed annually to approximately US$13.11 billion of tobacco industry–sponsored cigarette advertising and promotion (Federal Trade Commission [FTC], 2007), much of which is designed to appeal to specific subgroups of smokers (Ling & Glantz, 2002b). In an effort to counter the tobacco industry's influences on smoking behavior, several mass-media campaigns have been developed and evaluated, with some promising effects. For example, the California Tobacco Control Program, which included a comprehensive mass media component, led to a significant decline in smoking prevalence (Pierce, Emery, & Gilpin, 2002) and smoking-related heart disease (Fichtenberg & Glantz, 2000) in California in its first 3 years. The Massachusetts statewide campaign was associated with reductions in smoking initiation and progression to established smoking (Biener, Harris, & Hamilton, 2000; Siegel & Biener, 2000). Arizona and Oregon also reported initial decreases in smoking prevalence when an increased cigarette tax and antitobacco campaigns were introduced concurrently (Siegel, 2002). Sustained rates of prevalence decrease are not yet known. Among youth, increased exposure to antitobacco advertisements appears to reduce the likelihood of current smoking in a dose–response fashion (Farrelly, Davis, Haviland, Messeri, & Healton, 2005; Terry-McElrath et al., 2007). For example, the "Truth" campaign in Florida was successful in positively changing youths' attitudes toward tobacco use (Farrelly et al., 2002).

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Initially, promising findings have led to exploration of the types of appeals that are most and least persuasive. One report suggests that antitobacco appeals emphasizing the themes of tobacco industry manipulation and secondhand smoke are most effective for teens, whereas fear appeals tend to be less effective at creating positive attitudes and beliefs about not smoking (Goldman & Glantz, 1998; Sly, Hopkins, Trapido, & Ray, 2001). Although Biener (2002) reported that antitobacco advertisements emphasizing normative messages of social disapproval were ineffective, Pechmann, Zhao, Goldberg, and Reibling (2003) found normative messages to be associated positively with intentions to quit smoking. Others have found that increased use of graphic images, portrayal of the tobacco industry as manipulative, and social normative–themed advertisements increase quit intentions or are rated as being relatively more compelling advertisements than advertisements without these features (Biener, Ji, Gilpin, & Albers, 2004; Wakefield, Flay, Nichter, & Giovino, 2003). Antitobacco advertisements that evoke fear and sadness have been rated as more effective in inviting quit attempts (Biener et al., 2000), suggesting that eliciting negative emotions and arousal may affect intentions. Although these findings have begun to shed light on critical components of effective messages, additional theory-based communication research on message effectiveness and mechanisms of effect is warranted to inform the development of more efficacious antitobacco campaigns (Flay & Sobel, 1983; Siahpush, Wakefield, Spittal, & Durkin, 2007; Worden, Flynn, & Secker-Walker, 1998).

Theoretical frameworks

Two complementary theories can inform the design of antitobacco messages. Activation theory (Donohew, Lorch, & Palmgreen, 1998) focuses on features of message content and format that are postulated to affect attention to and processing of health-related messages. The integrative model of behavior prediction (Fishbein, 2000) postulates mechanisms that underlie individual behavior change.

Activation theory. Activation theory (Donohew et al., 1998) includes two fundamental tenets: (a) individuals have biologically based differences in their need for stimulation and arousal (referred to as sensation seeking; Zuckerman, 1990) and (b) the potential for a stimulus (i.e., message) to attract and sustain attention is determined by how well its features match the individual's need for stimulation.

Message sensation value (MSV) is the construct used to characterize these message features. It refers to the audio, visual, and content features of a public service announcement (PSA) that elicit sensory, affective, and arousal responses (Morgan, Palmgreen, Stephenson, Lorch, & Huyle, 2003; Palmgreen, Stephenson, Everett, Baseheart, & Francies, 2002). MSV ratings take into account the following three components: (a) a visual component, which rates the presence of cuts and edits, special visual effects, and intense images; (b) an audio component, which rates sound saturation (e.g., ambient conversation or street-level noise), and the presence of music and sound effects; and (c) a content component, which rates the presence of action images, unexpected format, and surprise endings (Morgan et al., 2003). These message features have been shown to affect attention to messages (Lang, Chung, Lee, & Zhao, 2005) and physiological responses associated with arousal (i.e., skin conductance and heart rate; Lang, Schwartz, Chung, & Lee, 2004).

Activation theory predicts that a PSA low in sensation value will be less likely to grab the attention of a person high on the dimension of sensation seeking because it will not produce the necessary orienting response and arousal. Consequently, exposure to and processing of the information would be limited, which would reduce the persuasive impact of the message. Indeed, recent data on national antidrug media campaigns suggest that the antimarijuana campaign produced significant positive changes in attitudes and behavior among high sensation-seeking adolescents and no effects among low sensation seekers (Palmgreen, Lorch, Stephenson, Hoyle, & Donohew, 2007). High sensation seekers also express a preference for novel, arousing, and dramatic (i.e., high MSV) message campaigns (Palmgreen, Donohew, Lorch, Hoyle, & Stephenson, 2001).

Although activation theory has not yet been applied to the evaluation of media communications to change smoking behavior, abundant evidence indicates that sensation seeking is a risk factor for smoking (Stephenson & Southwell, 2006). For example, in a prospective study of over 250 high school students, sensation seeking predicted progression to regular cigarette smoking (Skara, Sussman, & Dent, 2001). Similarly, in a large community sample of adolescents, high sensation seekers were twice as likely to be smokers (Kopstein, Crum, Celentano, & Martin, 2001).

The integrated model. Predictions about the mechanisms that mediate the main and interacting effects of MSV on behavior may be informed by the theory of reasoned action (Fishbein & Ajzen, 1975; Fishbein et al., 2001) and the broader integrative model of behavior prediction (IM; Fishbein, 2000). According to this model, intention to perform a behavior is a key determinant of behavior. This intention is a function of three determinants—the person's attitude toward performing the behavior, the person's perception of the social (or normative) pressure exerted on him or her to perform the behavior, and the person's belief in his or her ability to perform the behavior (self-efficacy). In support of the IM, attitudes and subjective norms have been found to be significant predictors of behavioral intention to smoke (O'Callaghan, Callan, & Baglioni, 1999). Other studies have shown that perceived behavioral control or self-efficacy also is a strong predictor of smoking intentions and behavior (Cote, Godin, & Gagne, 2004; O'Callaghan et al., 1999).

We have developed a measure of argument strength (AS; described in Methods; Cappella, 2006; Zhao, Strasser, Cappella, Lerman, & Fishbein, 2009) that has origins in the research of perceived effectiveness of antidrug messages (Fishbein, Hall-Jamieson, Zimmer, von Haeften, & Nabi, 2002) and in the elaboration likelihood model (Petty & Cacioppo, 1986), such that strong arguments are considered more persuasive than weak arguments when a message is processed in an elaborated way. The elaboration likelihood model posits that attitudes are derived from both central and peripheral persuasive communication and that attitudes drive behaviors.

The present study

The present study tested the effects of specific message features in antitobacco PSAs using theory-based physiological and self-report outcome measures. Specifically, we used a 2×2 factorial design to evaluate the main and interacting effects of four different PSA conditions within an experimental laboratory investigation: (a) high MSV–high AS, (b) high MSV–low AS, (c) low

MSV–high AS, and (d) low MSV–low AS. Based on the literature and the theoretical frameworks described earlier, we tested the following primary hypotheses:

1. MSV main effect. PSAs high in MSV will have greater effects on physiological measures of arousal (i.e., increased skin conductance and heart rate) and emotion (decreased corrugator supercilii and increased zygomaticus major activity) and on IM-based measures (attitudes, beliefs, efficacy, norms, and intentions), relative to low MSV PSAs.
2. MSV by sensation-seeking interaction. Smokers high in sensation seeking will have better outcomes with high, compared with low, MSV PSAs, whereas smokers low in sensation seeking will have better outcomes with low, compared with high, MSV PSAs.
3. Argument strength main effect. PSAs high in AS will have greater positive effects on the primary outcomes.

In addition, we tested two alternative hypotheses for the MSV × AS interaction. Based on activation theory, one would predict that high MSV PSAs would attract increased attention; as such, the effects of AS would be stronger in high MSV PSAs than in low MSV PSAs. However, the elaboration likelihood model (Petty & Cacioppo, 1986) would lead us to consider the alternative hypothesis. Specifically, high MSV PSAs would be expected to distract attention away from the central argument. According to this theory, the effects of AS on the outcomes of interest may be greater for the low versus the high MSV PSA conditions. Finally, we examined the contribution of incorporating the physiological measures into a model of IM measures predicting intentions to quit.

Methods

Characterization of antitobacco PSAs

Topic and theme. Cigarette smoking PSAs were requested from the Centers for Disease Control, American Legacy Foundation, and several state departments of health; 569 were acquired. Trained raters viewed each PSA for content to identify a subset that (a) promoted seeking smoking cessation treatment or portrayed the negative consequences of continuing to smoke, (b) targeted adults, and (c) were 30 s in duration. Three trained raters were in agreement with the characterizations of PSA topics (kappa = .89, $p < .001$), and 99 PSAs met the three selection criteria.

Message sensation value. Three trained raters viewed the 99 PSAs and rated each for MSV features using a scoring template (visual range = 0–10, audio range = 0–5, and content range = 0–5) based on work by Morgan et al. (2003). Counts of cuts and edits were converted to low (0–6), moderate (7–14), and high (>15) before MSV summary scores were created. Interrater reliability of MSV scoring between pairs of raters was high (Kendall's tau = .906, $p < .001$).

Argument strength. First, two trained raters viewed the PSAs and transcribed the explicit and implicit messages of each PSA. Next, two different raters viewed the PSAs while reviewing the corresponding messages and edited these messages to generate a single statement reflecting the central argument (or arguments) of each PSA (e.g., "If the health harms of smoking are not enough to get you to quit, consider quitting for your children and those you love," and "Although you may think smoking helps you cope, if you don't soon quit you will eventually die"). The statements generated reflected the full range of arguments made in the PSA.

Next, we conducted a shopping mall intercept survey of 300 current smokers to collect ratings of the transcribed central arguments. Participants were presented with 12 of the 99 central arguments in a balanced design such that each argument was rated 36 times. After being presented with each argument (in text-only form), participants were asked if the statement (a) is a reason for quitting smoking that is believable, (b) is a reason for quitting smoking that is convincing, (c) is a reason for quitting smoking that is new to me, (d) is a reason for quitting smoking that applies to me, (e) gives a reason for quitting smoking that is important to me, (f) put thoughts in my mind about quitting smoking, (g) put thoughts in my mind about wanting to continue smoking, (h) helped me feel confident about quitting smoking, (i) would help my friends quit smoking, (j) made me want to quit smoking, and (k) is a strong or weak reason. Participants responded to each item using a 5-point scale (1 = strongly disagree to 5 = strongly agree). Consistent with thought-listing scoring procedures, we subtracted the thoughts about continuing to smoke score (item g) from the thoughts about quitting smoking score (item f) to create a valenced thoughts item. Argument strength scores were created by summing the responses to the above items. An overall AS score was then created for each PSA by taking the mean of the 36 individual scores for that PSA.

PSA selection

Four groups of PSAs were then created: (a) high MSV–high AS, (b) high MSV–low AS, (c) low MSV–high AS, and (d) low MSV–low AS. PSAs exceeding one *SD* from the mean on each of the two dimensions were selected for use in the present study; 16 PSAs met this criterion (four in each group). Titles of the PSAs selected were (a) high MSV–high AS: "Lung," "Funeral," "Outside the bar," and "Family reunion"; (b) high MSV–low AS: "Fashion show," "Gala event," "Mother's keeper," and "Derek Parra"; (c) low MSV–high AS: "Chemicals," "Cigarette pack," "Emergency room-Rick series," "Missing my Grandpa"; and (d) low MSV–low AS: "Shaun," "Terrified," "Stealing," and "Girlfriends."

Overview of experimental design and procedure

The factorial design for the experiment included two manipulated variables: MSV and AS. Eligible participants were assigned randomly to one of the four conditions. Participants within each condition were exposed to the four PSAs in that set while physiological responses were measured. Following the PSAs, participants were asked to complete assessments of attitudes, beliefs, self-efficacy, social norms, and intention to quit smoking to determine the PSAs' persuasive impact.

Participant screening

Individuals responding to recruitment flyers and advertisements participated in an initial telephone contact at which eligibility was determined. Eligible individuals were those aged 18–65 years who reported smoking at minimum nearly every day in the past 6 months, reported smoking a minimum of 10 daily

cigarettes, were not currently trying to quit smoking, and reported no current use of smoking cessation pharmacotherapies or counseling. All participants enrolled in the study from September 2005 to March 2007 completed the procedures; one participant was excluded due to invalid data, resulting in a final sample of 199.

Laboratory session

Participants arrived at the Transdisciplinary Tobacco Use Research Center Biobehavioral Smoking Laboratory for a single 90-min session. After giving informed consent, they provided an exhaled breath carbon monoxide sample (Vitalograph; Lenexa, KS) for biochemical verification of smoking status, as well as demographic and smoking history measures. Measures and PSAs were presented via a 17-in. computer monitor using MediaLab Research Software (Empirisoft, New York, NY) with the participant seated in a comfortable chair approximately 1 m away. Participants completed the session measures alone in the observation room so as to minimize bias from investigator–participant or participant–participant interaction.

Measures

Covariates. Standard questionnaires (Lerman et al., 1997) were administered at the beginning of the session to assess demographics, smoking history, and current smoking rate. The Fagerström Test for Nicotine Dependence (Heatherton, Kozlowski, Frecker, & Fagerström, 1991), a six-item, self-report measure of nicotine dependence (range = 0–10), with satisfactory internal consistency (Cronbach's alpha = .64) and high test–retest reliability (r = .88), also was administered.

Sensation seeking (Zuckerman, 1990) was assessed with eight items used previously in populations of viewers of antidrug advertisements (Palmgreen et al., 2001). Questions pertained to liking of new, exciting, and dangerous activities and were accompanied by 4-point response scales (1 = agree strongly to 4 = disagree strongly). Similar sensation-seeking measures have been shown to moderate effects in psychophysiological studies (Hutchison, Wood, & Swift, 1999). Responses to all items were reverse coded and then summed to produce an overall index of sensation seeking (Cronbach's alpha = .80).

Psychophysiological outcome measures. Four physiological assessments (skin conductance, heart rate, zygomatic electromyography, and corrugator electromyography) were performed during the initial viewing of each PSA and during 30-s baselines prior to each PSA presentation. Physiological measures were determined by mean change, defined as the mean value during PSA presentation minus the last 10 s of the preceding 30-s baseline (Carter & Tiffany, 2001).

Skin conductance, reported in microSiemens, is a measure of sympathetic nervous system activity and has been used as a measure of arousal (Lang, Chung, Lee, Shin, & Schwartz, 2005). For this measure, participants had their nondominant hand cleaned with distilled water, after which two disposable sensors were attached (EL-507, Biopac, Goleta, California), one each to the thenar and hypothenar eminence.

Heart rate has been used as a measure of arousal (Lang, Greenwald, Bradley, & Hamm, 1993; Potter, Lang, & Bolls, 1997), and a significant positive relationship with self-report measures has been observed. To collect electrocardiogram (ECG) readings, disposable sensors (EL-503, Biopac; Goleta, CA) were placed below the right collarbone and the left forearm after the areas were cleaned with an alcohol wipe. Time (in milliseconds) between R-spikes was used to calculate heart rate from ECG and is reported in beats per minute.

Zygomatic and corrugator facial muscle responses have been used as indices of affect (Cacioppo & Petty, 1979), in response to antidrug message exposure (Bolls, Lang, & Potter, 2001), and have been shown to be associated with positive affect and smiling and negative affect and frowning, respectively (Tassinary & Cacioppo, 2000). Small (4 mm, EL-254, shielded) pairs of sensors were placed over the corrugator supercilii and zygomaticus major muscle regions to assess facial muscle responses after the areas had been cleansed with an alcohol wipe. The outcome measures were mean change in zygomatic and corrugator activity and are reported in microvolts.

All physiological responses were collected using Ag/AgCl sensors connected to a Biopac Systems MP150 unit (Goleta, California) linked to a laptop computer running AcqKnowledge software (version 3.8.1). Data were collected at a 1,000 Hz sampling rate and filtered off-line at 10–500 Hz. Movement artifact was reduced by technician instruction for participant movement to be minimized during PSA presentation, and any unusual movement was documented by the research technician. Baseline and PSA onset were event marked in the AcqKnowledge data file. The last 10 s of each preceding 30-s baseline was used to establish physiological baseline to minimize carryover effects of the preceding PSA.

Self-reported outcome measures

After viewing the PSAs, participants completed the following measures: 7 items on attitude toward quitting smoking (Cronbach's alpha = .73), 7 items on negative beliefs and 6 items on positive beliefs about quitting smoking (Cronbach's alpha = .72 and .73), 10 items on perceived self-efficacy (Cronbach's alpha = .92), a social norms measure consisting of four belief items weighted by four motivation items, and intentions to quit smoking (Fishbein et al., 2001; Norman, Conner, & Bell, 1999; Yzer, Cappella, Fishbein, Hornik, & Ahern, 2003).

Data analyses

Descriptive statistics were obtained for all variables. Of the continuous outcome variables, change in skin conductance and corrugator activity were highly positively skewed (skewness = 2.32 and 2.27, respectively). Because some values on these variables were negative, a constant was added to all values to bring the minimum value on each variable to 1, after which a transformation was applied to reduce skewness. In each instance, the least powerful transformation necessary to bring skewness to under 1.0 (selecting from Tukey's ladder of powers; Tukey, 1977) was used. For skin conductance, the base-10 logarithm was used (skewness = 0.91). For corrugator activity, the inverse transformation was used (skewness = −0.17); the resulting scores were then reflected (i.e., multiplied by –1) to preserve the original ordering of the values. None of the other continuous outcome variables were very highly skewed (skewness = −1.19 to 1.17); thus, no transformations were applied to them.

Next, covariates to be included in the multivariate models of outcomes were identified by examining the associations of

each potential covariate with AS and MSV. For continuous covariates, the tests used were *t* tests by AS, *t* tests by MSV, and analyses of variance (ANOVAs) using AS and MSV as the predictors. For noncontinuous covariates, chi-square tests and regressions (logistic, ordinal logit, or multinomial logit) were used in place of *t* tests and ANOVAs. Variables displaying associations with AS or MSV at a *p* value of less than .10 in any analysis were selected for inclusion as covariates. Linear regression models of each outcome were then estimated. In all models, predictors were AS, MSV, sensation seeking, age, cigarettes per day, marital status (never married vs. other), and the following interactions: AS by MSV and MSV by sensation seeking. All predictors were entered as a block, after which nonsignificant ($p > .10$) interactions were allowed to drop out one by one in order of *p* value; after this, main effects of sensation seeking, age, cigarettes per day, and marital status were allowed to drop out if nonsignificant ($p > .10$) and not involved in significant interactions. Finally, the linear regression of intention was repeated, including attitudes, efficacy, positive and negative beliefs, and social norms as predictors. After the final model was obtained, the physiological measures were added to determine the extent to which they made an independent contribution to the prediction of intention to quit smoking.

Results

Characteristics of study sample

Of the 199 participants in the final sample, 109 (54.8%) were male, 122 (61.3%) were White, 94 (47.2%) were never married, 117 (58.8%) had some education beyond high school, and 110 (55.3%) were employed full or part time. Mean age was 43.2 years ($SD = 11.97$), mean number of cigarettes smoked per day at baseline was 21.6 ($SD = 15.6$), and mean score at baseline on nicotine dependence was 5.35 ($SD = 2.34$). A total of 49 (24.6%) were assigned to the high MSV–high AS condition, 48 (24.1%) to the high MSV–low AS condition, 49 (24.6%) to the low MSV–high AS condition, and 53 (26.6%) to the low MSV–low AS condition.

Identification of covariates

Eight variables were considered as potential covariates (age, sex, ethnicity, marital status, educational level, employment status, cigarettes per day, and nicotine dependence level). Of these, three were found to have associations with either AS or MSV at a *p* value of less than .10: age, which was associated with AS, $t(197) = 1.83$, $p = .068$; cigarettes per day, which was associated with AS, $t(197) = 1.81$, $p = .072$; and marital status, which was associated with MSV, $\chi^2(1) = 3.75$, $p = .053$. These three covariates were therefore included in all initial models of outcome variables and were retained if the *p* value was less than .10.

Multivariate models of primary outcomes

Physiological measures. The final linear regression models of the physiological outcome measures are presented in Table 1. In the model of change in heart rate, AS had a marginal effect ($p = .053$): Heart rate increased more among participants who viewed PSAs high in AS (all values represented as mean [*SD*]: low AS = 0.14 [1.16], high AS = 0.46 [1.14]). In the model of the logarithm of change in skin conductance, the main effect of AS was significant ($p = .021$): Skin conductance increased more among participants who viewed PSAs high in argument strength (low AS = 0.19 [0.32], high AS = 0.31 [0.47]). In addition, there was an inverse correlation between skin conductance change and age ($p = .007$). In the model of the inverse of change in corrugator activity, there was a significant effect of MSV ($p = .012$): Activity increased more among participants viewing PSAs high in MSV (low MSV = 0.03 [0.16], high MSV = 0.10 [0.22]).

Attitudes, beliefs, self-efficacy, social norms, and intentions. As shown in Table 2, the model of perceived efficacy included a significant main effect of MSV ($p = .035$) and a significant interaction of MSV by sensation seeking ($p = .036$). Among participants low in sensation seeking, low MSV PSAs elicited higher self-efficacy ratings; among those high in sensation seeking, the reverse was true. We also found a significant main effect of MSV in the model of beliefs about negative

Table 1. Final linear regression models of physiological measures

Outcome/predictor	*B*	*SE*	*p* value	95% *CI*
Heart rate				
AS	0.32	0.16	.053	(−0.004, 0.64)
MSV	0.20	0.16	.23	(−0.12, 0.52)
Skin conductance[a]				
AS	0.028	0.012	.021	(0.004, 0.05)
MSV	0.006	0.012	.62	(−0.02, 0.03)
Age	−0.001	0.001	.007	(−0.002, 0.00)
Zygomaticus major activity				
AS	0.01	0.04	.75	(−0.07, 0.09)
MSV	0.03	0.04	.40	(−0.05, 0.11)
Corrugator supercilii activity[b]				
AS	0.01	0.01	.22	(−0.01, 0.03)
MSV	0.02	0.01	.012	(0.01, 0.04)

Note. AS = argument strength; MSV = message sensation value.

[a]Base-10 logarithm.

[b]Inverse.

Table 2. Final linear regression models of attitudes, self-efficacy, beliefs, social norms, and intentions to quit

Outcome/predictor	*B*	*SE*	*p* value	95% *CI*
Attitudes toward quitting				
AS	−0.05	0.14	.74	(−0.33, 0.24)
MSV	−0.02	0.14	.88	(−0.31, 0.26)
Marital status	0.31	0.14	.03	(0.02, 0.60)
Perceived self-efficacy				
AS	−0.05	0.08	.55	(−0.21, 0.11)
MSV	−0.83	0.39	.03	(−1.60, −0.06)
Sensation seeking	−0.01	0.01	.28	(−0.04, 0.01)
Age	0.01	0.004	.09	(−0.001, 0.01)
Cigarettes per day	−0.01	0.003	.01	(−0.01, −0.001)
MSV by sensation seeking	0.04	0.02	.04	(0.003, 0.08)
Beliefs about positive consequences				
AS	0.04	0.09	.66	(−0.14, 0.23)
MSV	−0.04	0.10	.71	(−0.22, 0.15)
Marital status	0.18	0.10	.06	(−0.01, 0.36)
Beliefs about negative consequences				
AS	0.03	0.10	.77	(−0.16, 0.22)
MSV	1.03	0.47	.03	(0.10, 1.96)
Sensation seeking	0.04	0.02	.02	(0.01, 0.07)
MSV by sensation seeking	−0.04	0.02	.06	(−0.09, 0.002)
Social norms				
AS	−1.51	1.47	.31	(−4.42, 1.40)
MSV	−1.98	1.47	.18	(−4.88, 0.92)
Cigarettes per day	0.08	0.05	.09	(−0.01, 0.17)
Marital status	4.86	1.48	.01	(1.94, 7.77)
Sensation seeking	−0.44	0.17	.01	(−0.77, −0.11)
Intention to quit				
AS	−0.11	0.10	.28	(−0.31, 0.09)
MSV	−0.01	0.10	.91	(−0.21, 0.19)
Age	0.01	0.004	.02	(0.001, 0.019)

Note. AS = argument strength; MSV = message sensation value.

consequences ($p = .03$) and an interaction that approached significance ($p = .063$); among participants low in sensation seeking, high MSV PSAs elicited higher negative belief scores, whereas there was no effect of MSV among participants high in sensation seeking. We found no main or interacting effects of MSV or AS in the models of attitudes, beliefs about positive consequences, social norms, or intention to quit. Cigarette smoking rate was related inversely to efficacy ($p = .008$), and there was a positive trend of age with efficacy ($p = .096$). Finally, the effect of marital status was significant in the model of attitudes ($p = .04$) and approached significance in the model of positive beliefs ($p = .064$); in both instances, participants who were never married had lower scores.

Models predicting intentions to quit

The final linear regression model of intention to quit, incorporating attitudes, beliefs, social norms, and self-efficacy is presented in Table 3. As shown in the table, the model was significant, $F = 23.56$, $p < .01$, $R^2 = .380$; however, the addition of the psychophysiological measures did not increase the variance accounted for in the model ($R^2 = .381$). In neither model was MSV nor AS associated with intention to quit smoking.

Discussion

Hypotheses 1 and 2 focused on the main effect of MSV condition and the interaction of MSV by sensation seeking on physiological measures of attention and arousal and self-report measures of attitude change. Although only one physiological measure differed by MSV, increased corrugator activity in the high versus low MSV PSA condition, this result is consistent with previous research that reported increased corrugator response during counterattitudinal message presentation (Cacioppo & Petty, 1979), when viewing negative affect–rated words and pictures (Larsen, Norris, & Cacioppo, 2003) and when listening to negative emotionally toned radio messages (Bolls et al., 2001). A positive correlation between high MSV (or message valence) and negative affect (Bolls et al., 2001; Palmgreen et al., 2002) may partly explain our results observed with corrugator activity, which is often associated with negative affect and frowning (Tassinary & Cacioppo, 2000).

The two self-report measures provided partial support for hypotheses 1 and 2. Consistent with activation theory, low sensation seekers reported greater post-PSA self-efficacy in the low MSV compared with high MSV condition; the reverse was true

Table 3. Predictive models of intention to quit, using (a) IM measures and (b) including physiological measures

Predictor	*B*	*SE*	*p* value	95% *CI*
Model A: $R^2 = .380$				
AS	−0.07	0.08	.43	(−0.22, 0.10)
MSV	0.03	0.08	.72	(−0.13, 0.19)
Attitude	0.23	0.05	.01	(0.13, 0.32)
Self-efficacy	0.20	0.08	.01	(0.05, 0.36)
Beliefs about positive consequences	0.27	0.07	.01	(0.14, 0.40)
Social norms	0.01	0.004	.01	(0.005, 0.021)
Model B: $R^2 = .381$				
AS	−0.06	0.08	.45	(−0.23, 0.10)
MSV	0.04	0.08	.68	(−0.13, 0.20)
Attitude	0.23	0.05	.01	(0.13, 0.32)
Self-efficacy	0.20	0.08	.02	(0.04, 0.36)
Beliefs about positive consequences	0.27	0.07	.01	(0.13, 0.40)
Social norms	0.01	0.004	.01	(0.005, 0.021)
Heart rate	0.004	0.04	.92	(−0.07, 0.08)
Skin conductance	0.011	0.10	.02	(−0.19, 0.22)
Zygomaticus major activity	−0.08	0.15	.59	(−0.38, 0.22)
Corrugator supercilii activity	−0.06	0.22	.79	(−0.49, 0.38)

Note. AS = argument strength; MSV = message sensation value.

for high sensation seekers. A similar pattern of results was found for beliefs about the negative consequences of quitting; however, the interaction effect was not significant ($p = .06$). These effects did not translate to effects on intentions to quit, which contrasts prior evidence that sensation-seeking adolescents have a stronger preference for high MSV antidrug PSAs (Palmgreen et al., 1991) and are more likely to change behavior when viewing such PSAs than are individuals low on sensation seeking (Everett & Palmgreen, 1995; Palmgreen et al., 2002, 2007). However, high sensation seekers also exhibit less physiological arousal and greater recall than low sensation seekers when viewing antidrug PSAs (Lang, Chung, Lee, Shin, & Schwartz 2005), illustrating the complexities in elucidating what makes a PSA effective. It is possible that the MSV manipulation in the present study was less salient than that used in prior research, in part because of the smoking cessation theme. Alternatively, adolescents may be more sensitive to MSV manipulations (Lang, Chung, Lee, & Zhao, 2005; Palmgreen et al., 2001) than are adult populations.

Our third hypothesis regarding the effects of argument strength received partial support. In the present study, the high AS condition produced greater arousal than the low AS condition, as evidenced by greater increases in skin conductance responses and marginally greater increases in heart rate consistent with message content and arousal research (Everett & Palmgreen, 1995; Palmgreen et al., 1991). However, this increased arousal did not appear to produce differential effects of AS on attitudinal or intention measures.

Finally, although the IM measures reasonably predicted quit intentions, the inclusion of psychophysiological measures produced no increase in explained variance. Research has demonstrated the utility of physiological responses in understanding message processing and recall (Lang, Chung, Lee, Shin, & Schwartz 2005; Palmgreen et al., 2001). Physiological responses may be less informative in characterizing effective messages in an older, smoking population such as ours, than in younger subjects viewing illicit drug content media (Lang, Chung, Lee, & Zhao, 2005; Palmgreen et al., 2001). Further research is needed.

Limitations

A few considerations should be noted. First, participants in the present study were exposed to a single set of four PSAs within each condition. Although we observed some interesting effects of MSV and AS on physiological and self-report measures, the single exposure appears to have been insufficient to produce persuasive effects, similar to what has been observed elsewhere (Worden & Flynn, 2002). Yet, sustained low-level (monthly) exposure to antitobacco messages has been shown to effectively reduce smoking prevalence and increase antitobacco sentiment (Emery et al., 2005). Laboratory studies with repeated sessions might better capture the effect of repeated, low-frequency PSA exposures akin to an antitobacco campaign. Comprehensive media campaigns, such as those launched in California, have been shown to effectively dissuade smoking initiation and increase quit attempts and, therefore, are an essential component of attempts to address tobacco dependence (Pierce et al., 2002).

Second, moderating effects of sensation seeking were observed only for self-efficacy and were not robust and consistent across multiple outcomes. Sensation seeking may have weaker persuasive effects among adults with established behaviors, such as smoking, compared with effects on the initiation of new behaviors among adolescents (Ling & Glantz, 2002a). Also the persuasive effects of the smoking-themed PSAs used in the present study may differ from those of the anti-drug PSAs used in most prior research. It would be interesting to test the PSA feature manipulations in the present study in a population of adolescents to identify those features that are most persuasive with respect to not engaging in smoking behavior.

Summary

The present study represents the first comprehensive theory-based experimental investigation of the effects of different features of antitobacco PSAs. As such, it provides a framework for future research to identify the critical elements of effective antitobacco PSAs. Given the significant morbidity and mortality associated with tobacco use, such research should be a public health imperative and a priority in the field of health psychology. Tobacco industry marketing and advertising expenditures have approximately doubled since 1998 (FTC, 2007), far outpacing antitobacco efforts, which, by some estimates have declined by 28% since 2002 (Centers for Disease Control and Prevention, 2005). Although considerable research has been done to better understand prevention of smoking initiation in adolescents, less research has focused on how to effectively persuade smoking cessation among inveterate smokers.

The PSAs in the present study were coded for a specific theme: encouraging smoking cessation and the negative health consequences associated with not quitting. Participants reported smoking a minimum of 10 daily cigarettes and not being interested in quitting. By focusing the PSA theme and recruiting a current smoking population, we were best able to examine the effects of specific message features, namely MSV and argument strength, on physiological and self-report outcomes in current smokers. Within this sample, AS had a significant effect on physiological measures but no effect on attitudes, beliefs, efficacy, norms, or intention to quit smoking. It is plausible that, in a group with no intention of quitting, receiving a single session of high AS messages about cessation might alter physiological responses but not self-report measures. Future research should examine the effect of multiple exposures to campaigns and investigate whether physiological responses relate to later changes in attitudes and beliefs. MSV had effects on efficacy and negative beliefs, which were moderated by level of sensation seeking, illustrating the necessity to characterize the sample being studied. Further work is warranted on identifying the specific aspects of PSA formatting that lead to improved efficacy, attitudes, beliefs, and intentions to quit smoking.

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None declared.

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