Reactance to Health Warnings Scale: Development and Validation

Marissa G. Hall,

Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Paschal Sheeran,

Department of Psychology, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Seth M. Noar,

School of Journalism and Mass Communication, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Kurt M. Ribisl,

Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Laura E. Bach, and

Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Noel T. Brewer

Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina

Lineberger Comprehensive Cancer Center, University of North Carolina

Abstract

Background—Health warnings may be less effective if they elicit *reactance*, a motivation to resist a threat to freedom, yet we lack a standard measure of reactance.

Address correspondence regarding this article to: Noel T. Brewer, Department of Health Behavior, University of North Carolina, 325 Rosenau Hall CB7440, Chapel Hill, NC 27599. ntb@unc.edu. Phone: +1 919-966-3282. Fax: +1 919-966-2921.

Purpose—We sought to validate a new health warning reactance scale in the context of pictorial cigarette pack warnings.

Methods—A national sample of adults (*n*=1,413) responded to reactance survey questions while viewing randomly assigned pictorial or text warnings on images of cigarette packs. A separate longitudinal sample of adult smokers received the warnings on their own cigarette packs (*n*=46).

Results—Factor analyses identified a reliable and valid 27-item Reactance to Health Warnings Scale. In our experimental study, smokers rated pictorial warnings as being able to motivate quitting more than text warnings. However, five reactance scale factors weakened the warnings' impact (*anger, exaggeration, government, manipulation*, and *personal attac*k; all *p*<.05).

Conclusions—The Reactance to Health Warnings Scale had good psychometric properties. Reactance weakened the impact of pictorial warnings on smokers' evaluation of the warning's ability to motivate quitting.

Health messaging is an increasingly popular tool for encouraging people to engage in healthier behaviors, such as vaccination and cancer screening. However, reactance to persuasive health messages may undermine the impact of those messages. *Reactance* is "the motivational state that is hypothesized to occur when a freedom is eliminated or threatened" (Brehm 1981, p. 37). Scholars have explored two types of reactance in depth: *trait* reactance, a personality characteristic reflecting one's predisposition to be reactant across various situations, and *state* reactance (sometimes called "psychological reactance"), which refers to reactance in response to a specific situation or message. Our paper focuses on state reactance and hereafter uses the term "reactance" to refer to this construct.

Two theories provide support for the idea that reactance to health warnings may undermine their impact. First, the Theory of Psychological Reactance (1, 2) posits that in response to feeling that one's freedom is threatened, some individuals may experience reactance, which can, in turn, result in undesirable outcomes. Second, the Extended Parallel Process Model (EPPM) suggests that, under certain circumstances (e.g., low self-efficacy), fear-inducing messages may provoke resistance to those messages that includes, but is not limited to, defensive avoidance, denial, and reactance (3, 4).

Reactance has been defined and operationalized in a variety of ways. Brehm, the originator of the Theory of Psychological Reactance, argued that reactance could not be measured directly (2). However, in recent years, several researchers have operationalized reactance as a combination of anger and counterarguments against the message, frequently measured using a thought-listing task (5–9). In addition, EPPM defines reactance as the state that "occurs when perceived freedom is reduced and an individual believes that the communicator is trying to make him or her change" (Witte 1992, p. 332). Researchers testing EPPM have operationalized reactance as a combination of perceived manipulation, message minimization, and message derogation (10).

Drawing on this rich body of empirical and conceptual work, we define reactance as an emotional and cognitive resistance to a warning, characterized by 1) a perceived threat to one's freedom, 2) anger, and 3) counterarguments against the warning such as denial or derogation. The threat to freedom component of reactance captures beliefs about being manipulated, personally affronted, and intruded upon; this component reflects cognitive resistance to a perceived loss of liberty engendered by the warning. The counterarguing component captures cognitive responses to the warning in terms of both its value (the warning provides no new or useful information) and its relevance to the self (the warning does not speak to me or my circumstances). Potential consequences of reactance, such as avoidance of the warning or increased urges to smoke, are not included in our conceptualization as these constructs should be construed as outcomes, and not components, of reactance.

Examining reactance in the context of tobacco control may be particularly important as tobacco remains the leading cause of preventable morbidity and mortality, causing nearly six million deaths each year worldwide (11). A recent review of tobacco industry documents and news articles found that the tobacco industry has strategically incorporated themes of freedom in marketing and public relations messages (12). For example, a marketing campaign for blu eCigs®, a prominent e-cigarette producer, employs the slogan "Take Back Your Freedom," emphasizing individuals' freedom to use tobacco products without interference from government regulation or public health interventions. Thus, tobacco industry rhetoric may heighten smokers' feelings that their freedom to smoke is increasingly threatened, potentially exacerbating reactance to tobacco control campaigns.

Pictorial cigarette pack warnings with vivid images depicting the health consequences of smoking are an especially promising tobacco control strategy (13). Compared to text warnings, pictorial warnings are more effective at communicating the health risks of smoking, increasing quit intentions, and potentially encouraging cessation (14–16). A recent meta-analysis of 37 experimental cigarette pack warning studies found that pictorial warnings were more effective than text warnings for 20 of 25 outcomes, including intention to quit smoking (16). However, the review found that pictorial warnings caused greater reactance than text warnings ($d=-.46$, $p<.001$). This finding supports fear appeals theory, which suggests that warnings that are threatening will produce greater reactance than warnings that are not threatening (3, 17). Pictorial warnings are typically gruesome and vivid, and therefore likely to be more threatening, than text-only warnings. Thus, we propose our first hypothesis: Pictorial warnings will elicit greater reactance than text-only warnings (Hypothesis 1).

The Theory of Psychological Reactance suggests that reactance will be heightened when the behavior being challenged is perceived as highly important to the individual (1). As smokers place greater importance on smoking than non-smokers, they may feel more strongly that health warnings threaten their freedom to smoke and therefore exhibit greater reactance. This leads to our second hypothesis: Smokers will experience greater reactance to cigarette pack warnings than non-smokers (Hypothesis 2).

The Theory of Psychological Reactance also posits that the importance of the focal behavior in question and perceived threat to freedom can interact, such that reactance may be heightened when the behavior is perceived as highly important (1, 2). Therefore, we offer a third hypothesis: Smoking status will moderate the relationship between pictorial warnings and reactance, such that pictorial warnings will elicit more reactance than text-only warnings among smokers, but this difference will be smaller for non-smokers (Hypothesis 3).

Fear appeals and reactance theory suggests that reactance to fear-inducing health messages may partially undermine the positive effect of those messages (3, 17). Specifically, reactance may weaken the intended impact of the message (e.g., quitting smoking) or lead to boomerang effects (e.g., increased smoking). Experimental studies have focused on whether pictorial warnings increase reactance, but have not explored whether reactance undermines their positive effects (18–20). Thus, we explore the potential undermining effects of reactance through three additional hypotheses. Reactance will partially suppress the positive relationship between pictorial warning exposure and perceived effectiveness of the warnings (Hypotheses 4). Reactance will partially suppress the positive relationship between pictorial warning exposure and the warning's ability to motivate quitting. (Hypothesis 5). Reactance will partially mediate the positive relationship between pictorial warning exposure and avoidance of the warnings (Hypothesis 6).

Studying reactance can shed light on how smokers and non-smokers respond to cigarette pack warnings and can provide vital information for enhancing public health initiatives to curb tobacco use. A high-quality measure of reactance to health warnings may help researchers and policymakers to accurately characterize the effects of reactance on psychosocial and behavioral outcomes. However, the field lacks a validated and reliable measure of reactance to health warnings. In the present research, we therefore sought to develop and evaluate the psychometric properties of a new reactance scale using data from both a large-scale, national survey and an intensive longitudinal study of smokers. We sought to examine experimentally whether reactance weakens the ability of the warning to motivate quitting but strengthens motivation to avoid the warnings.

Method

Participants

In May 2014, we recruited a convenience sample of 1,500 US cigarette smokers and non-smokers ages 18 or older through Amazon Mechanical Turk (mTurk). mTurk, a web-based platform, is widely used for social science research and is known to generate reliable and valid data (21–23). The recruitment message encouraged smokers to participate. We excluded 87 respondents who failed standard procedures for ensuring data quality, leaving an analytic sample of 1,413 respondents.

In July and August 2014, we recruited 46 North Carolina smokers ages 18 or older to participate in a four-week cigarette pack labeling study previously described by Brewer et al. (2014) (24). We defined current smoking as having smoked at least 100 cigarettes during one's lifetime and currently smoking every day or some days (25). We excluded pregnant women, people who smoke only roll-your-own cigarettes, and cigarillo-only smokers.

Demographic characteristics of the online study and pack labeling study participants appear in Supplementary Table 1.

Procedures

Participants in the online study took a survey while viewing an image of an unbranded cigarette pack with a randomly assigned warning on the top half. They viewed one of five randomly assigned warnings with an image depicting the health consequences of smoking and related text (n=1,204, Figure 1) or one of the same five warnings without the image (n=209). The pictorial warnings were a subset of the nine warnings that the US Food and Drug Administration (FDA) proposed for implementation in 2011, but are not currently in use due to a court challenge (26). We used unequal random assignment (6:1) to allocate more participants to the pictorial warning condition, allowing us to perform our scale development work with smokers who saw the pictorial warnings. Randomization to pictorial or text condition yielded equivalent groups on eight of nine variables, including trait reactance, although participants had lower levels of education in the text than in the pictorial condition (p<.05; Supplementary Table 1). Participants received $3 for completing the survey.

Participants in the pack labeling study visited our study offices at baseline and then once a week for four weeks, completing a survey on a computer at each visit. Smokers brought eight days' worth of cigarettes to the first four appointments. We randomly assigned participants to receive one of five pictorial warnings also used in the online study. While participants were taking the survey, study staff removed the package cellophane and applied the same pictorial warning label to the top half of the front and rear panels of each cigarette pack. At the final appointment, each participant received information about smoking cessation resources. Participants received a cash incentive at the end of each visit, totaling $185. The University of North Carolina at Chapel Hill Institutional Review Board approved both study protocols.

Measures

Item development—To develop the Reactance to Health Warnings Scale, we created 87 survey items that fit the reactance dimensions (i.e., anger, perceived threat to freedom, and counterarguing against the warning) described in the introduction. To develop the items, we relied on previously published measures (5, 27, 28), qualitative studies that captured the natural language people use when talking about reactance (29, 30), and feedback from tobacco and reactance researchers on both item wording and whether our items reflected the dimensions we were intending to measure.

Online study—Smokers completed all 87 reactance items, while non-smokers answered a subset of 69 of the items that excluded 18 items relevant only to smokers. We randomized the order of the reactance items in five blocks. The five-point response scale ranged from "strongly disagree" (coded as 1) to "strongly agree" (coded as 5).

To allow us to examine construct validity of the scale, the survey assessed trait reactance (31), trait anger (32), internal locus of control (33, 34), state anxiety (35, 36), social

desirability (impression management subscale) (37), and smoker prototypes (38, 39). The survey assessed perceived effectiveness of the warning using two items that asked participants to rate how much the warning would discourage non-smokers from smoking and make non-smokers concerned about the health effects of smoking. Among smokers, the survey assessed avoidance with ten items that asked how much smokers would try to avoid the warning (e.g., "How likely is it that you would try to avoid thinking about the warning on your cigarette packs?"), adapted from the Population Assessment of Tobacco and Health Study (40). Finally, among smokers, the survey assessed the warning's motivational ability with the question "How much would having this warning on your cigarette packs make you want to quit smoking?" Cronbach's alpha for multiitem measures was .70 or higher (for details, see Supplementary Table 2).

Pack labeling study—We assessed reactance with the scale developed in the online study. Again, we randomized the order of the items. We report data on reactance for three time points: immediately after viewing the assigned warning that we had applied to their cigarette packs at the first appointment (i.e., baseline), at week 1, and at week 4. The survey items are available upon request.

Data Analysis

Analyses used SPSS Statistics version 19.0 and Stata version 13.1 with two-tailed tests and a critical alpha of 0.05. Analyses used data from the online survey, unless otherwise noted.

Factor analysis—To identify reactance factors, we conducted exploratory factor analysis with direct oblimin rotation using data from smokers who viewed pictorial warnings online (n=510), as this is the primary population of interest for pictorial cigarette pack warnings. To identify the number of reactance factors to retain, we used visual inspection of scree plots and eigenvalues greater than 1 (41). For each factor, we identified three items with high factor loadings and the greatest conceptual coherence. We then ran a confirmatory factor analysis using data from non-smokers (n=816) as further validation of the results from the exploratory factor analysis. We evaluated several indicators of model fit, including the root mean square error of approximation (RMSEA<.08) (42), the Tucker-Lewis Index (TLI>.90) (43) and the Bentler Comparative Fit Index (CFI>.90) (44). We estimated correlations between all nine factors and then calculated mean factor scores and internal reliability using Cronbach's alpha, separately for smokers and non-smokers. We also calculated factors' test-retest reliability between baseline, week 1, and week 4 using data from the pack labeling study.

Validity—To assess convergent, discriminant, and predictive validity, we examined the correlations between the reactance factors with hypothesized variables among participants in the online study. For convergent validity, we derived our hypotheses from the Theory of Psychological Reactance (1, 2), anticipating that reactance factors would correlate positively with higher trait reactance, being a smoker, and greater positive smoker prototypes. For discriminant validity, we expected that reactance factors would not be correlated with trait anger, state anxiety, internal locus of control, or socially desirable responding, as these are hypothesized to be conceptually distinct constructs from reactance. In terms of predictive

validity, we drew upon the fear appeals literature (3, 17) and hypothesized that reactance factors would be negatively associated with perceived effectiveness of the warnings and motivational ability, and positively associated with avoidance of the warnings. Predictive validity analyses initially controlled for trait reactance, but the pattern of results was similar and we thus report unadjusted correlations.

Mediation of the impact of warnings—Using data from smokers and non-smokers, we examined how study condition (pictorial vs. text warning) and smoking status affected perceived effectiveness and reactance factor scores using a 2×2 between-subjects analyses of variance. To determine whether reactance differed among the pictorial conditions, we performed analyses of variance with post-hoc Tukey tests.

We conducted mediational analyses for each reactance factor using three different outcomes, with the goal of determining whether suppression or mediation was occurring (Figure 2). Suppression occurs when the direct and mediated effects have opposite signs, in this case demonstrating that the mediator detracts from the effectiveness of pictorial warnings (45). In contrast, a direct and mediated effect with the same sign signals mediation, indicating that the mediator contributes to the effectiveness of pictorial warnings (45). We report results as unstandardized path coefficients (β). Mediation analyses controlled for education, which differed across conditions. First, we examined the extent to which each reactance factor mediated the relationship between pictorial warning exposure and perceived effectiveness of the warning. Then, among smokers, we examined mediation between pictorial warning exposure and the warning's motivational ability. Finally, we repeated analyses with avoidance as the dependent variable, among smokers. We then ran multiple mediation analyses with each of the three outcomes using the factors that emerged as statistically significant mediators in simple mediation models. Mediation analyses used bootstrapped 95% confidence intervals with 5,000 repetitions; this approach does not assume that indirect effects are normally distributed (46). Mediation results appear in Tables 6–11. In all tables, the *a* column lists the association between pictorial warning exposure and reactance factors. The *b* column depicts the association between the reactance factors and the outcome, controlling for pictorial warning exposure. The *c* column depicts the association between pictorial warning exposure and the outcome, and the *c'* column lists the association between pictorial warning exposure and the outcome, controlling for the reactance factors. The *mediated effect* column represents a*b, which is the same as c-c'.

Moderation by smoking status—Using data from smokers and non-smokers, we tested whether smoking status moderated the effect of pictorial warnings on reactance and perceived effectiveness using 2×2 between-participants analyses of variance.

Results

Exploratory Factor Analysis

Exploratory factor analysis of data from smokers exposed to pictorial warnings (*n*=510) revealed a ten-factor solution. Eigenvalues for the factors ranged from 32.9 to 1.0. We examined other solutions (including four, six, and nine factors), but they yielded solutions

that were less conceptually meaningful. We dropped one factor that did not have clear loadings.

The resulting 27-item scale had nine factors with clear conceptual meaning (Table 3). The confirmatory factor analysis model with non-smokers fit the data well (RMSEA=.05, CFI=.96, TLI=.95). Correlations between reactance factors appear in Table 2. The factors had high internal consistency among smokers in the online study (median α=.83) and in the pack labeling study (median α=.72; Table 1). The factors had good test-retest reliability at one week (median r=.69), three weeks (median r=.62), and four weeks (median r=.62; Table 4) among smokers in the pack labeling study. A non-smoker version of the scale, which includes the six factors asked of nonsmokers in the online study, also showed high reliability (median α=.82; Table 1).

Scale Validity

Convergent validity analyses found that higher reactance factor scores were associated with higher trait reactance (median r=.30, Supplementary Table 2) in the online study, as expected. Scores on all reactance factors, except for *common knowledge*, were higher among smokers, providing support for Hypothesis 2 (median r=.20). Six of nine factors (all but *common knowledge, personal attack*, and *discounting*) correlated with having more positive smoker prototypes (median r=.15). Discriminant validity analyses revealed that most reactance factors correlated weakly and inconsistently with trait anger, internal locus of control, state anxiety, and social desirability (median r ranged from −.07 to .08).

Predictive validity analyses among online study smokers demonstrated that all reactance factors except for *common knowledge* and *discounting* were associated with lower perceived effectiveness of the warning (median r=−.15; Supplementary Table 2). Eight of nine factors (all but *discounting*) were associated with lower motivational ability (median r=−.28). Eight of nine factors (all but *common knowledge*) were associated with greater avoidance of the warning (median r=.18).

Mediation of Impact of Warnings

Reactance—Supporting Hypothesis 1, pictorial warnings elicited greater reactance than text warnings on five factors, (*anger, exaggeration, government, manipulation*, and *personal attack*; all p<.05, Tables 5 and 6) among online study participants. In contrast, the text warnings engendered higher ratings of *common knowledge* than the pictorial warnings (p<.05). Pictorial and text warnings elicited similar scores on the remaining two factors (*derogation* and *discounting*). Comparisons of the five warnings in the pictorial condition revealed few differences in reactance (Supplementary Table 3).

Perceived effectiveness—Pictorial warnings generated higher perceived effectiveness than text warnings (β=.38, p<.001; Tables 5 and 6). Mediation analyses showed that four reactance factors (*anger, exaggeration, government*, and *manipulation*) suppressed the relationship between exposure to pictorial warnings and perceived effectiveness, providing support for Hypothesis 4. The decrease in warning effectiveness attributable to reactance ranged from β=−.05 to −.09 (all p<.05, Table 6). *Common knowledge* exhibited the opposite

pattern, mediating rather than suppressing the association. Pictorial warning exposure elicited lower levels of *common knowledge* which, in turn, led to lower perceived effectiveness (increase in path coefficients=.02; $p<.05$). Derogation did not mediate the relationship between pictorial warning exposure and perceived effectiveness. Multiple mediation analyses of significant suppressors revealed that *exaggeration* and *government* each suppressed the relationship between pictorial warning exposure and perceived effectiveness (total mediated effect=−.10; $p<.05$; Table 7).

Warnings' motivational ability—Smokers rated pictorial warnings as being more able to motivate quitting than text warnings (β=.30, $p<.001$; Tables 5 and 8). Supporting Hypothesis 5, mediation analyses showed that five reactance factors (*anger, exaggeration, government, manipulation*, and *personal attack*) each suppressed the relationship between pictorial warning exposure and participants' evaluation of the warning's ability to motivate quitting. The decrease in motivational ability attributable to reactance ranged from β=−.07 to −.19 (all $p<.05$). Again, *common knowledge* mediated, rather than suppressed, the association ($p<.05$). The remaining factors did not mediate or suppress the relationship between pictorial warning exposure and motivational ability. Multiple mediation analyses revealed that *anger, exaggeration*, and *government* each suppressed the relationship between pictorial warning exposure and warning's motivational ability (total mediated effect=−.19; $p<.05$; Table 9).

Avoidance—Smokers reported wanting to avoid pictorial warnings more than text warnings (β=.57, $p<.001$; Tables 5 and 10). Pictorial warnings elicited greater *anger, exaggeration, government, manipulation*, and *personal attack*, which, in turn, were associated with higher avoidance, consistent with Hypothesis 6. The increase in path coefficients ranged from β=.05 to .13 (all $p<.05$). The remaining factors did not mediate the association between pictorial warnings and avoidance. Multiple mediation analyses revealed that *anger* remained the only significant mediator of the association between pictorial warning exposure and avoidance (total mediated effect=.09; $p<.05$; Table 11).

Moderation by Smoking Status

Smoking status did not moderate the effect of pictorial warnings on reactance or perceived effectiveness (Hypothesis 3; interaction with reactance factors F range=.00–.93, all $p>.33$; Table 5).

Discussion

The Reactance to Health Warnings Scale builds on decades of fear appeals theory and reactance research that conceptualizes reactance as an amalgam of perceived threat to freedom, anger, and counterarguing against the warning. Our findings support the importance of assessing these three features of reactance, using a 9-factor scale, in two samples (smokers and non-smokers recruited online, and smokers recruited in North Carolina). The Reactance to Health Warnings Scale had good psychometric properties; the scale was reliable and exhibited convergent, discriminant, and predictive validity. Pictorial warnings elicited greater reactance than text-only warnings on five of nine factors (Hypothesis 1), and scores on all but one reactance factor were higher among smokers than

non-smokers (Hypothesis 2). We did not find support for Hypothesis 3, as smoking status did not moderate the effect of pictorial warnings on reactance. Potential explanations for this null finding include the smaller cell sizes for smokers and for the text-only condition. In addition, the potential threat to freedom imposed by the warning was hypothetical in nature for both smokers and non-smokers, which could have minimized differential reactions to pictorial warnings. Finally, the lack of an interaction could indicate that smokers and non-smokers simply do not experience differential levels of reactance to pictorial warnings. Future research could provide insight as to whether this finding is replicated in other circumstances.

Crucially, reactance was negatively associated with perceived effectiveness of the warning and motivational ability, and was positively associated with avoidance. Moreover, reactance partially attenuated the impact of pictorial (vs. text) warnings on perceived effectiveness (Hypothesis 4) and motivational ability (Hypothesis 5) in an experimental test. Reactance also partially mediated the association between pictorial warnings and avoidance (Hypothesis 6).

The present research offers a more comprehensive and nuanced view of reactance compared to previous research. Previous studies distinguished between anger and negative cognitions as components of reactance (5, 6), and this distinction was also supported here. However, the present findings indicate that reactance to health warnings involves not merely anger and undifferentiated negative thoughts about the message; rather, cognitive features of reactance appear to involve a suite of eight distinct responses to messages. These eight factors appear to reflect two key pieces of the definition of reactance: perceived threat to freedom (e.g., *government* and *manipulation* factors) and counterarguing (e.g., *exaggeration* and *discounting* factors).

The importance of these distinctions became apparent in analyzing the impact of type of warning (pictorial vs. text) on outcomes. Five reactance factors – *anger, exaggeration, government, manipulation*, and *personal attack* – attenuated the impact of pictorial cigarette pack warnings on the warning's motivational ability and mediated the impact on avoidance of the warnings. Four of these five factors (all but *personal attack*) weakened the impact of pictorial warnings on perceived effectiveness. In multiple mediation analyses, *anger* suppressed the impact of pictorial warnings on the warning's motivational ability and avoidance. *Government* and *exaggeration* both suppressed the impact of pictorial warnings on perceived effectiveness and motivational ability.

Taken together, these analyses indicate the key role of *anger* in attenuating the effectiveness of pictorial warnings. *Government* and *manipulation* – two factors that reflect the belief that one's freedom has been threatened – also detracted from the effectiveness of pictorial warnings. *Exaggeration*, a type of counterarguing, consistently weakened the impact of the warnings. In this study, other counterarguing factors (e.g., *self-relevance, common knowledge, derogation*, and *discounting*) did not suppress the impact of pictorial warnings. However, we must acknowledge that the present research concerned one particular set of warnings, and other counterarguing factors could weaken the impact of other warnings. For instance, it is possible that warnings that invite smokers to identify with images of smokers

who have developed lung cancer could lead to counterarguing in the form of *self-relevance* or *discounting*, whereas warnings that emphasize the carcinogenic properties of cigarettes could engender *common knowledge* and *derogation* as forms of counterarguing. Further research is needed to test these possibilities.

Few experiments have examined whether pictorial warnings lead to greater reactance than text warnings. Erceg-Hurn and Steed (2011) randomly assigned 250 Australian adult smokers to view pictorial or text warnings; pictorial warnings led to more reactance than text warnings. However, the study measured only the emotional element of reactance (e.g., angry, annoyed), but not the cognitive components of reactance. Moreover, the study focused on assessing whether pictorial warnings predicted greater reactance, rather than whether reactance undermined message impact. More recently, LaVoie (2015) randomly assigned 435 US college students to view a pictorial or text-only warning, assessing reactance using the Dillard and Shen (2005) measure of anger and cognition. They found that pictorial warnings increased counterarguing, but not anger, and they did not examine whether reactance weakened the impact of the warnings on smoking-related outcomes. The present research thus fills an important gap in the literature by undertaking formal analyses to test whether reactance attenuates the impact of pictorial warning labels on key outcomes. Our findings also offer experimental evidence to support the results of one previous observational warning label study that found a negative relationship between exaggeration and quit intentions (47).

Understanding the role of reactance should help to inform tobacco control policy. The 2009 Family Smoking Prevention and Control Act mandated that pictorial warnings appear on the top half of the front and back of all cigarette packs in the US (48). However, tobacco industry litigation has prevented FDA from implementing the 9 warnings that it developed (19). FDA is currently in the process of developing a set of pictorial warnings that will withstand legal challenges (26). Experimental evidence supports the superiority of pictorial warnings over text warnings on numerous outcomes, including quit intentions (16). Moreover, observational studies conducted before and after pictorial warning implementation have demonstrated increases in knowledge about smoking risks (49), calls to quitlines (50), and foregoing cigarettes (51). The present research also highlights the promise of pictorial warnings as an effective tobacco control strategy, as pictorial warnings were viewed as more motivating than text warnings. Given the large body of research indicating the effectiveness of pictorial warnings, it would be unwise to conclude that pictorial warnings are counterproductive simply because they produce reactance, as others have done (20). However, our research suggests that reactance may *partially* weaken the impact of pictorial warnings on perceived effectiveness and the ability of the warning to motivate quitting, although text-only warnings performed worse overall. The impact of reactance on smoking behavior represents a challenging but important direction for future research.

Strengths of our study include our use of an experimental design and the inclusion of both smokers and non-smokers. Moreover, our new scale has a strong conceptual grounding and may fill an important gap for researchers. However, our use of convenience samples means that the generalizability of findings to other populations will need to be established in future

work. The magnitude of some correlations in our convergent validity analyses was modest; further testing may help to strengthen the case for the scale's construct validity.

Conclusions

The Reactance to Health Warnings Scale is a valid and reliable measure of reactance to health warnings that benefits from experimental evidence that several components of reactance weakened the impact of exposure to pictorial warnings on multiple outcomes. This scale may prove useful to tobacco control researchers, for instance, in evaluating anti-smoking public service announcements or warnings about other tobacco products such as electronic cigarettes. Moreover, the Reactance to Health Warning Scale can readily be adapted to other types of anti-tobacco messages (e.g., public service announcements) and other health behaviors (e.g., diet, physical activity, sun protection), and could prove valuable to researchers in health psychology, health communication, and behavioral medicine. Future research should validate the scale in different populations (e.g., adolescents, Spanish-speakers), and should also examine the behavioral effects of reactance to health warnings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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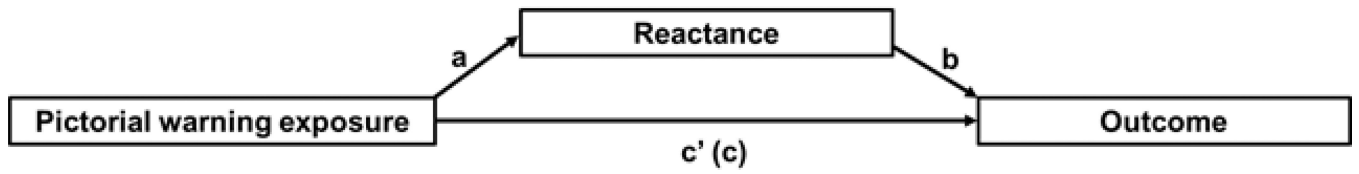
Figure 1.
Pictorial warnings used in experiment

Figure 2.
Mediational pathways

Table 1

Psychometric properties of the Reactance to Health Warnings Scale

| | Mean (SD) | Factor Loadings | | | | | | | | | |
		Anger	Self-relevance	Common knowledge	Exagg-eration	Govern-ment	Manip-ulation	Personal attack	Derog-ation	Discou-nting	Med-ian α
SMOKERS (*n*=510, online study)											
This warning makes me feel aggravated	2.65 (1.26)	.95									
This warning annoys me	2.78 (1.34)	.77									
This warning irritates me	2.89 (1.34)	.76									
This warning is meant for other smokers, not me[a]	2.14 (1.08)		.74								
This warning is not relevant to me	2.32 (1.09)		.71								
This warning is only meant for hard-core smokers	2.38 (1.15)		.69								
The information in this warning is common knowledge	4.06 (.93)			.73							
I've heard the information in this warning a million times	4.07 (1.00)			.71							
I already knew about the harms in this warning	4.26 (.93)			.67							
The health effect on this warning is overblown	2.41 (1.17)				.63						
This warning exaggerates the health effects of smoking	2.35 (1.15)				.61						
This warning is misleading	2.14 (1.17)				.59						
Smoking is legal, so the government should stop interfering with smokers' freedom	3.39 (1.23)					.90					
The government shouldn't require warnings like this on packs	3.10 (1.35)					.71					
It's not the government's job to warn me about the risks of smoking	3.15 (1.27)					.71					
This warning is trying to manipulate me	3.23 (1.30)						.53				
This warning is manipulating smokers	2.99 (1.24)						.45				
This warning is trying to boss me around[b]	2.62 (1.24)						.34				
This warning tells me I'm bad because I	2.93 (1.29)							.53			

	Mean (SD)	Factor Loadings									
		Anger	Self-relevance	Common knowledge	Exagg-eration	Govern-ment	Manip-ulation	Personal attack	Derog-ation	Discou-nting	Med-ian α
smoke[a]											
This warning tells me that I'm stupid[c]	2.69 (1.27)	.37						.45			
I am being told that I am a fool by this warning[a]	2.93 (1.27)							.34			
This warning is pointless	2.36 (1.20)								.67		
This warning is stupid	2.37 (1.20)								.62		
This warning is useless	2.44 (1.19)								.58		
I'll quit long before I suffer the health effect in this warning[a]	3.35 (1.07)									.55	
I would worry more about this warning if I expected to smoke for many years[a]	3.44 (1.18)									.48	
The health effect in this warning won't catch up to me for a long time[a]	2.96 (1.12)									.40	
Eigenvalues		32.9	6.0	3.9	2.2	1.8	1.6	1.4	1.1	1.0	
Factor mean (SD)	--	2.78 (1.22)	2.28 (1.10)	4.13 (.76)	2.30 (.98)	3.22 (1.12)	2.95 (1.08)	2.85 (1.10)	2.39 (1.08)	3.25 (.83)	
Cronbach's alpha	--	.92	.83	.75	.86	.84	.80	.83	.88	.58	.83
SMOKERS (n=46, pack-carrying study)											
Factor mean (SD, baseline)		2.04 (.97)	1.66 (.59)	3.71 (.82)	1.80 (.75)	2.40 (.89)	1.96 (.89)	2.03 (.91)	1.77 (.79)	2.49 (.86)	
Cronbach's alpha (baseline)		.92	.52	.69	.75	.67	.76	.78	.72	.65	.72
NON-SMOKERS (n=816, online study)											
Factor mean (SD)	--	2.13 (1.03)	--	4.13 (.64)	1.87 (.77)	2.68 (1.03)	2.68 (.96)	--	2.05 (.90)	--	
Cronbach's alpha	--	.91	--	.64	.80	.83	.77	--	.85	--	.82

Note. Table shows factor loadings greater than .30. SD = standard deviation. Eigenvalues and factor loadings are from the exploratory factor analysis with 87 items, showing the items we retained in the scale.

[a] Item not asked of non-smokers

[b] Wording used with non-smokers: "This warning is trying to boss smokers around."

[c] Wording used with non-smokers: "This warning tells smokers that they're stupid."

Table 2

Correlations among reactance scale factors

	Factors								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Anger (1)	1.00	--	.06	.52	.59	.57	--	.65	--
Self-relevance (2)	**.37**	1.00	--	--	--	--	--	--	--
Common knowledge (3)	**.16**	**−.04**	1.00	−.07	.18	.10	--	.17	--
Exaggeration (4)	**.52**	**.60**	**.00**	1.00	.48	.42	--	.55	--
Government (5)	**.65**	**.31**	**.33**	**.45**	1.00	.44	--	.60	--
Manipulation (6)	**.67**	**.36**	**.12**	**.56**	**.54**	1.00	--	.46	--
Personal attack (7)	**.72**	**.36**	**.22**	**.45**	**.54**	**.60**	1.00	--	--
Derogation (8)	**.62**	**.40**	**.22**	**.58**	**.58**	**.56**	**.56**	1.00	--
Discounting (9)	**.17**	**.41**	**.11**	**.25**	**.18**	**.17**	**.15**	**.11**	1.00

Note.

Bold data below diagonal are for smokers. Not bold data above the diagonal are for non-smokers.

--=not asked of non-smokers.

Table 3

Reactance scale conceptualization

Factor	Factor definition
Anger	Feeling of annoyance or hostility toward health warning
Self-relevance	Perception that health warning is not personally relevant
Common knowledge	Belief that information in health warning is already well-known
Exaggeration	Belief that health warning is overstated
Government	Resistance to government intrusion via health warning
Manipulation	Perception of threat to freedom imposed by health warning
Personal attack	Belief that health warning is a personal insult or affront
Derogation	Belief that the health warning is worthless
Discounting	Disregarding immediacy of the harms in health warning

Table 4

Reactance scale test-retest reliability among smokers

	Baseline Mean (SD)	Week 1 Mean (SD)	Week 4 Mean (SD)	Baseline - week 1 r	Baseline - week 4 r	Week 1 - week 4 r
Anger	2.04 (1.03)	1.96 (.92)	1.96 (.96)	.72**	.68**	.89**
Self-relevance	1.66 (.58)	1.50 (.55)	1.54 (.51)	.55**	.62**	.53**
Common knowledge	3.68 (.84)	3.73 (.71)	3.61 (.61)	.57**	.51**	.51**
Exaggeration	1.79 (.74)	1.75 (.76)	1.70 (.73)	.75**	.51**	.58**
Government	2.37 (.88)	2.16 (.84)	2.24 (.87)	.69**	.72**	.69**
Manipulation	1.94 (.91)	1.94 (.87)	1.83 (.81)	.62**	.55**	.62**
Personal attack	2.04 (.96)	1.78 (.79)	1.77 (.73)	.71**	.66**	.81**
Derogation	1.62 (.68)	1.54 (.63)	1.50 (.59)	.79**	.72**	.73**
Discounting	2.52 (.87)	2.27 (.81)	2.33 (.72)	.67**	.44*	.55**
Median				.69	.62	.62

Note. Data from pack-carrying study (*n*=46 smokers). SD = standard deviation.

*
$p<.05$,

**
$p<.001$

Table 5

Mean factor scores, by experimental condition and smoking status

	Text (n=209) Mean (SD)	Pictorial (n=1,204) Mean (SD)	F	Non-smokers (n=816) Mean (SD)	Smokers (n=597) Mean (SD)	F	Interaction F
Reactance							
Anger	2.00 (1.03)	2.40 (1.16)	22.24 **	2.07 (1.01)	2.72 (1.21)	121.34 **	.04
Self-relevance	2.22 (.92)ᵃ	2.28 (.96)ᵃ	.29	--	2.27 (.95)	--	--
Common knowledge	4.35 (.68)	4.13 (.69)	18.89 **	4.16 (.64)	4.16 (.76)	.02	.01
Exageration	1.81 (.77)	2.05 (.89)	13.64 **	1.84 (.77)	2.26 (.96)	79.42 **	.93
Government	2.54 (1.03)	2.88 (1.10)	17.42 **	2.59 (1.03)	3.17 (1.10)	105.43 **	.13
Manipulation	2.25 (.93)	2.80 (1.01)	52.53 **	2.61 (.97)	2.86 (1.07)	20.07 **	.78
Personal attack	2.59 (1.05)ᵃ	2.85 (1.10)ᵃ	4.33 *	--	2.81 (1.10)	--	--
Derogation	2.24 (1.08)	2.19 (.99)	.44	2.05 (.93)	2.41 (1.07)	44.22 **	.32
Discounting	3.20 (.95)ᵃ	3.25 (.83)ᵃ	.23	--	3.24 (.85)	--	--
Outcomes							
Perceived effectiveness	2.51 (.92)	2.88 (.85)	33.18 **	2.88 (.91)		.00	
Motivational ability	2.09 (.98)ᵃ	2.40 (1.07)ᵃ	6.48 *	--	--	--	--
Avoidance	2.24 (.79)ᵃ	2.82 (.92)ᵃ	30.24 **	--	--	--	--

Note. Data from online study (n=1,413).

ᵃData only from smokers (text-only n=87, pictorial n=510).

--=not asked of non-smokers. SD = standard deviation.

*
$p < .05$,

**
$p < .001$

Table 6

Mediators of association between pictorial warning exposure and perceived effectiveness

	a	b	c	c'	Mediated effect
Anger	.40 **	−.17 **	.38 **	.45 **	−.07 *
Common knowledge	−.22 **	−.10 *	.38 **	.36 **	.02 *
Exaggeration	.24 **	−.21 **	.38 **	.43 **	−.05 *
Government	.35 **	−.22 **	.38 **	.46 **	−.08 *
Manipulation	.53 **	−.16 **	.38 **	.47 **	−.09 *
Derogation	−.05	−.35 **	.38 **	.37 **	.02

Note. Data from online study (*n*=1,413). Table reports path coefficients for single mediator models, controlling for education. Shaded rows indicate suppression of the overall positive relationship between pictorial warning exposure and perceived effectiveness.

*
p<.05,

**
p<.001

Table 7

Multiple mediation of association between pictorial warning exposure and perceived effectiveness

	a	b	c	c'	Mediated effect
Anger	.40 **	−.04	.38 **	.48 **	−.01
Exaggeration	.24 **	−.07 *	.38 **	.48 **	−.02 *
Government	.35 **	−.15 **	.38 **	.48 **	−.05 *
Manipulation	.53 **	−.02	.38 **	.48 **	−.01
Total					−.10 *

Note. Data from online study (*n*=1,413). Table reports path coefficients for multiple mediator models, controlling for education. Shaded rows indicate suppression of the overall positive relationship between pictorial warning exposure and perceived effectiveness.

*
p<.05,

**
p<.001

Table 8

Mediators of association between pictorial warning exposure and motivational ability, among smokers

	a	b	c	c'	Mediated effect
Anger	.36 **	−.34 **	.30 *	.42 **	−.12 *
Self-relevance	.05	−.21 **	.30 *	.31 *	−.01
Common knowledge	−.23 *	−.34 **	.30 *	.22	.08 *
Exaggeration	.31 *	−.38 **	.30 *	.42 **	−.12 *
Government	.31 *	−.46 **	.30 *	.44 **	−.14 *
Manipulation	.61 **	−.32 **	.30 *	.49 **	−.19 *
Personal attack	.25	−.27 **	.30 *	.36 *	−.07 *
Derogation	−.11	−.51 **	.30 *	.24 *	.05
Discounting	.03	.01	.30 *	.30 *	.00

Note. Data from online study (smokers only, *n*=597). Table reports path coefficients for single mediator models, controlling for education. Shaded rows indicate suppression of the overall positive relationship between pictorial warning exposure and intention to quit.

*
p<.05,

**
p<.001

Table 9

Multiple mediation of association between pictorial warning exposure and motivational ability, among smokers

	a	b	c	c'	Mediated effect
Anger	.36 [*]	−.10	.30 [**]	.48 [**]	−.04 [*]
Exaggeration	.31 [*]	−.17 [**]	.30 [**]	.48 [**]	−.05 [*]
Government	.31 [*]	−.36 [**]	.30 [**]	.48 [**]	−.11 [*]
Manipulation	.61 [**]	−.01	.30 [**]	.48 [**]	−.01
Personal attack	.25	.08	.30 [**]	.48 [**]	.02
Total					−.19 [*]

Note. Data from online study (smokers only, n=597). Table reports path coefficients for multiple mediator models, controlling for education. Shaded rows indicate suppression of the overall positive relationship between pictorial warning exposure and motivational ability.

[*]
p<.05,

[**]
p<.001

Table 10

Mediators of association between pictorial warning exposure and avoidance of warning, among smokers

	a	b	c	c'	Mediated effect
Anger	.36*	.28**	.57**	.47**	.10*
Self-relevance	.05	.15**	.57**	.56**	.01
Common knowledge	−.23*	.05	.57**	.58**	−.01
Exaggeration	.31*	.16**	.57**	.52**	.05*
Government	.31*	.23**	.57**	.50**	.07*
Manipulation	.61**	.21**	.57**	.44**	.13*
Personal attack	.25	.27**	.57**	.50**	.07*
Derogation	−.11	.15**	.57**	.59**	−.02
Discounting	.03	.15**	.57**	.57*	.00

Note. Data from online study (smokers only, *n*=597). Table reports path coefficients for single mediator models, controlling for education. Shaded rows indicate consistent mediation of the overall positive relationship between pictorial warning exposure and avoidance of warning.

*
$p<.05$,

**
$p<.001$

Table 11

Multiple mediation of association between pictorial warning exposure and avoidance, among smokers

	a	b	c	c'	Mediated effect
Anger	.36 *	.22 **	.57 **	.48 **	.08 *
Exaggeration	.31 *	−.05	.57 **	.48 **	−.02
Government	.31 *	.06	.57 **	.48 **	.02
Manipulation	.61 **	−.02	.57 **	.48 **	−.02
Personal attack	.25	.10 *	.57 **	.48 **	.02
Total					.09 *

Note. Data from online study (smokers only, n=597). Table reports path coefficients for multiple mediator models, controlling for education. Shaded rows indicate suppression of the overall positive relationship between pictorial warning exposure and avoidance.

*
p<.05,

**
p<.001