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Reactions to tobacco warning labels: predictors and outcomes of adaptive and maladaptive responses

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Abstract

Background: The Extended Parallel Process Model (EPPM) responses have not been evaluated from verbal reactions to cigarette warning labels. We identified the EPPM responses in reactions to cigarette warning labels and evaluated their predictors and relationship with warning perceptions.

Methods: U.S. adult current smokers, transitioning smokers (quit in the past two years or currently quitting) and never smokers (n=1,838) saw nine of 81 cigarette warning labels. Participants freely wrote their thoughts after viewing the first label and reported perceived informativeness, negative emotions, and denial for this label. Responses were coded for the presence of the EPPM response categories. Multivariable logistic regression models described adaptive and maladaptive respondent characteristics, and linear regression models assessed the relationship between the response categories and label perceptions.

Results: Participants' responses contained adaptive (65.4%), maladaptive (16.5%), no response (14.7%), and mixed responses (both adaptive and maladaptive; 3.4%). Current smokers had decreased odds of adaptive response compared to never and transitioning smokers. Compared to text warnings, pictorial warnings were associated with increased odds of adaptive and decreased odds of maladaptive responses. Adaptive response was associated with increased odds of intentions to quit smoking. Adaptive respondents reported the highest levels of informativeness and negative emotions among the four response categories.

Conclusions: The finding demonstrating predominantly adaptive (and few maladaptive) responses to warning labels supports the continued use of fear appeals in warning label design. The greater adaptive and lower maladaptive responses to pictorial warnings could serve as additional evidence for FDA to implement pictorial warning labels.

Keywords

Extended Parallel Process Model (EPPM); cigarette warning labels; anti-smoking messages

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Competing interests:

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Introduction

Tobacco use increases the risk of multiple diseases and reduces life expectancy, but cessation can reverse this risk and is beneficial at any age (Jha et al., 2013; USDHHS, 2014). Anti-smoking messages, including health warning labels, inform tobacco users about the health risks and encourage quitting (WHO, 2005). Health warnings serve as a frequent direct communication about tobacco harms to the user (Hammond, 2011). Smokers who noticed tobacco warnings were more likely to affirm the health risks of smoking (Hammond, Fong, McNeill, Borland, & Cummings, 2006; Yong et al., 2015, 2013). Health warnings increase beliefs about harms of tobacco, negative attitudes towards smoking, intentions not to smoke, and intentions to quit smoking (Hammond, 2011; Noar, Hall, et al., 2016; Swayampakala et al., 2014; Thrasher et al., 2014).

Health warning labels typically take the form of fear appeals, defined as messages designed to motivate behavior change through fear by showing the negative consequences of unhealthy behavior (Dillard, 1994; Witte, 1992). The Extended Parallel Process Model (EPPM) (Witte, 1992) provides a theoretical framework for explaining audience's responses to fear appeals. According to the EPPM, persons who are exposed to fear appeals consider the severity of the threat and personal susceptibility to the threat. If the threat is not perceived as severe or personally relevant, then the fear is not aroused and further processing of the message stops (i.e., no response). High perceived threat induces fear, and the individual will then respond in one of two ways. First, those with high perceived efficacy will engage in danger control (i.e., adaptive response) which leads to positive changes in attitude, intention, and behavior. Second, those with low perceived efficacy will engage in fear control (i.e., maladaptive response), including defensive avoidance, reactance, and denial (downplaying the message or stating that the message is trying to manipulate them) (Ooms, Jansen, & Hoeks, 2016; Witte, 1992, 1994). In the case of tobacco use, fear appeals could lead to adaptive responses such as increased intention to quit, quit attempts, and intention to not use tobacco, or maladaptive responses such as denial of the threat and reactance (Cho et al., 2016; Popova, 2014; Thrasher et al., 2016; Wong & Cappella, 2009).

The EPPM suggests that the two types of responses – adaptive and maladaptive – are mutually exclusive (Witte, 1992). A meta-analysis supported this by showing the negative correlation between adaptive and maladaptive responses ($r = -.18$, $p < .05$, $k = 7$, $N = 955$) (Witte & Allen, 2000). Witte and Allen (2000) further argued that the “two responses cancel each other out (i.e., if one is defensively responding to a fear appeal and rejecting it, one is not making attitude, intention, or behavior changes)” (p. 601).

Previous EPPM studies typically categorized people as “adaptive” or “maladaptive” by using a discriminating score, calculated as the difference in perceived threat and perceived efficacy scores (Gore & Bracken, 2005; Witte, 1996). This approach has been criticized for the lack of precision and the potential for misclassifying people (Popova, 2012). Consequently, some scholars have called for evaluating adaptive and maladaptive responses that “organically emerge” from spontaneous reactions to messages (Abril, Szczypka, & Emery, 2017; Maloney, Lapinski, & Witte, 2011). Although the EPPM has been applied to examine reactions to anti-tobacco messages in cross-sectional (Gould, Watt, Cadet-James, & Clough,

2015), experimental (Popova, 2014; Wong & Cappella, 2009), and longitudinal (Cho et al., 2016; Thrasher et al., 2016) studies, only a few studies have examined how the response categories of EPPM emerge from audience's reactions to anti-tobacco messages (Abril et al., 2017; Emery, Szczypka, Abril, Kim, & Vera, 2014). These studies coded tweets about the U.S. Centers for Disease Control and Prevention's *Tips from Former Smokers* campaign (Centers for Disease Control and Prevention, 2016) into three categories: message acceptance, rejection, and disregard. While these studies provided useful insights into participants' reactions to anti-tobacco messages, they did not offer information about the characteristics of people posting those tweets; for example, how smoking status and demographic factors might have affected the twitter responses. Furthermore, only reactions in the form of tweets to an anti-smoking campaign were studied, and, to our knowledge, no study has examined how the response categories of EPPM emerge from audience's reactions to warning labels. The present study addressed these gaps by identifying the fear appeal response categories emerging from adults' verbal reactions to cigarette warning labels.

In their study on the tweets about the *Tips from Former Smokers* campaign, Emery et al. (2014) observed that 87% of the tweets demonstrated message acceptance (adaptive response). Another study that used EPPM to examine messages designed to deter smokers from using smokeless tobacco reported that the majority of the participants (53%) demonstrated danger control (adaptive response) (Popova, 2014). Based on this evidence, it was hypothesized that:

H1: The majority of the participants' verbal reactions to health warnings on cigarette packs will contain adaptive responses.

Because EPPM postulates that the evaluation and reaction to fear appeals are dependent on personality characteristics, prior experiences, and culture (Witte, 1992), we asked:

RQ1: What demographic and smoking-related factors, such as intentions to quit, are associated with maladaptive and adaptive responses?

We evaluated the extent to which participants who exhibited adaptive or maladaptive responses differed in terms of message perceptions (i.e., perceived informativeness, negative emotions (Popova, Owusu, Jenson, & Neilands, 2017) and denial (Witte, 1994)). According to the EPPM, when in danger control (adaptive response), people agree with the message and follow the message recommendations. Thus:

H2: Participants exhibiting an adaptive response will perceive warning labels as more informative than participants exhibiting a maladaptive response.

In contrast, when in fear control (maladaptive response), people engage in defensive mechanisms aimed at reducing fear, such as denial (Ooms et al., 2016; Witte, 1994). Thus:

H3: Participants exhibiting a maladaptive response will report greater levels of denial compared to participants exhibiting an adaptive response.

Finally, the EPPM positions adaptive (danger control) responses as primarily cognitive, and maladaptive (fear control) responses as primarily emotional (Witte, 1992). While the EPPM

does not directly specify which of the respondents (adaptive or maladaptive) experience greater fear or higher negative emotions when exposed to a threatening communication, it could be inferred based on the other propositions within the EPPM that both adaptive and maladaptive responses would result in a high level of fear. However, knowing that you could do something to avert the threat and are capable of doing it (high response and self-efficacy) would likely result in lower levels of fear and negative emotions than being helpless or incapable of doing something to avert the threat (low response or self-efficacy). Furthermore, past research has reported that the highest level of fear evoked by anti-tobacco messages was in the maladaptive (high threat, low efficacy) group (Popova, 2014). Therefore, it was hypothesized that:

H4: Participants exhibiting a maladaptive response will report greater levels of negative emotions compared to participants with an adaptive response.

Method

Participants

Participants were 1,838 U.S. adults aged 18+ years, recruited purposively based on age and smoking status through online recruitment strategies (e.g., web banners, website referrals, affiliate marketing, pay-per-click) by Toluna (www.toluna-group.com), a survey market research company. The study sample consisted of non-smokers (never smoked or smoked less than 100 cigarettes in their lifetime, $n=764$), current smokers (smoked at least 100 cigarettes in their entire life and were currently smoking cigarettes everyday or some days, $n=569$) and transitioning smokers (quit smoking within the past 2 years or currently trying to quit, $n=505$). Compared to the national distribution, the study sample had a higher proportion of females (51.3% and 61.8%, respectively) (U.S. Census Bureau: Population Division, 2015). Due to the purposive recruitment of smokers, the study sample also had a higher proportion of current smokers (31%) than the U.S. population (15.1%) (Jamal, 2016).

Procedure

This study was part of a larger experimental study on perceptions of various text and pictorial warning labels. For materials and results of the main study, see (blinded for review). Briefly, in an online experimental study, each participant saw nine warning labels randomly selected from 81 text-only and pictorial warning labels. The randomization of the selection and presentation was implemented in SAS using the PLAN procedure. The labels included the first 9 pictorial cigarette warning labels designed by the U.S. Food and Drug Administration (FDA) in three versions: 1) both text and picture (9 labels), 2) the text-only version (9 labels), and 3) picture-only version (9 labels). Based on labels in use in other countries and various anti-tobacco messages, additional 27 text and 27 pictorial labels were developed for this study. Similar to previous studies (Berg et al., 2011; Magnan & Cameron, 2015), we categorized non-FDA pictorial labels into 9 themes: harmful chemicals, statistics, life stories, metaphors, internal disease, external disease, impotence, surgery, and cancer cells. The non-FDA text labels were also categorized into 9 themes: harmful chemicals, statistics, life stories, metaphors, industry manipulation, addiction, loved ones, single word, and old Surgeon General warnings. We originally collected 42 pictorial and 37 text warning

labels based on existing tobacco warning labels from the database hosted by Canadian Tobacco Labeling Resource Center (<http://www.tobaccolabels.ca>), existing anti-tobacco campaigns (truth®, Tips from Former Smokers, and other campaigns available through Centers for Disease Control and Prevention Media Campaign Resource Center), and messages developed for our past studies by a professional marketing agency. Six researchers (postdoctoral fellows) independently categorized the pictorial and text labels into themes. The last author then compared the categorization and selected the themes that consistently emerged across coders and the labels that were consistently associated with these themes, resulting in the final set of 27 pictorial and 27 text warning labels.

After viewing the first label, participants were asked to freely write their thoughts about the label (thought-listing task) (Petty & Cacioppo, 1981). Thus, only responses to the first warning label were collected for the present study. In addition to the written responses, questions were asked to assess perceived informativeness, negative emotions, and denial of the label. At the end of the study, participants were debriefed that the labels were for research purpose only and had not been approved by the FDA. All participants completed electronic informed consent, and the study protocol was approved by the University of California San Francisco IRB. Median study time was 20 minutes, and the data were collected in 2015.

Measures

Response coding—All responses provided by participants after the first label were retrieved and coded. The unit of analysis was each participant's written response, with one response per participant since each participant only provided one open-ended response after seeing the first label. Each unit was coded for either presence (coded as 1) or absence (coded as 0) of 1) an adaptive response, defined as a response in line with the recommendations of the message, and 2) a maladaptive response, defined as a defensive response such as counterargument or denial of susceptibility. Adaptive and maladaptive categories were not mutually exclusive. Responses that were neither adaptive nor maladaptive were coded as "no response". A codebook was developed deductively based on the EPPM theoretical constructs and their operationalizations (Popova, 2012; Witte, 1992, 1996) to guide the coding process. Two independent coders first coded 10% of the responses, then discussed the disagreements, after which another random sample of 10% of the responses were coded independently. Interrater reliability, calculated based on the second random sample (10%) of the responses (Neuendorf, 2002), was acceptable (Krippendorff's alpha of 0.77 for adaptive responses and 0.80 for maladaptive responses) (Krippendorff, 2004). The rest of the responses were coded by one of the coders. After coding, responses were classified into four response categories: 1) no response (n= 304; responses that were neither adaptive nor maladaptive); 2) adaptive response (n= 1202); 3) maladaptive response (n= 270); and 4) mixed response (responses coded as having both adaptive and maladaptive responses; n= 62).

Perceived informativeness—Participants reported to what extent the label gave them a better understanding of the negative effects of smoking, presented something that happened in real life, was based on facts, portrayed the actual risk of smoking, and was informative (Cho, Shen, & Wilson, 2014; Magnan & Cameron, 2015; Teigen, 1985) (Cronbach's $\alpha=.85$).

93). Responses to all message perceptions items were on a 1 (not at all) to 9 (extremely) scale. Responses to the five items were averaged for each participant to form the informativeness score for the first label each participant saw.

Negative emotions—Participants reported to what extent they felt sad, angry, afraid, guilty, disgusted, and worried (Nonnemaker, Farrelly, Kamyab, Busey, & Mann, 2010; Popova, So, Sangalang, Neilands, & Ling, 2017) while looking at the label ($\alpha=.93$) on a 1 (not at all) to 9 (extremely) scale. Similar to informativeness, responses to the six items about the first label participants saw were averaged for each participant.

Denial—Participants were asked to what extent the label presented misleading information and exaggerated the health risks of smoking (McMahan, Witte, & Meyer, 1998) ($\alpha=.82$) on a 1 (not at all) to 9 (extremely) scale. The two items were averaged for each participant for the first label to form the denial score for the label which was used in this study.

Demographic and smoking information—We collected demographic information (sex, age, ethnicity, race, and education), and smoking-related information among current smokers (intentions to quit, number of cigarettes per day, and time to first cigarette) prior to showing the warning labels. Intentions to quit smoking were categorized into ‘no intention to quit’ (never expect to quit), ‘intention to quit someday’ (may quit in the future, but not in the next six months) and ‘intention to quit within six months’ (will quit in the next six months or will quit in the next month). Race/ethnicity was categorized into non-Hispanic white and other races. Educational level was grouped into high school or less, some college, and bachelor’s degree or higher. Age was categorized as 18–24 years, 25–44 years, 45–64 years and 65+ years.

Statistical Analysis

SAS version 9.4 (SAS Institute, Cary, NC, USA) was used to conduct data analysis. Descriptive analyses were performed to detail the characteristics of study participants and to examine the distribution of the response categories by demographic factors and smoking status. To examine factors associated with adaptive responses, we created a binary variable for adaptive responses: 1=Yes (any adaptive response, including mixed responses) and 0=No (no response or maladaptive only response). A similar procedure was used to create a binary variable for maladaptive responses: 1=Yes (any maladaptive response) and 0=No (no response or adaptive only response). Two multivariable logistic regression analyses were conducted with the adaptive and maladaptive binary response variables as outcomes and age, sex, race, smoking status, educational level, and type of message (pictorial vs. text-only) as independent variables for all participants. All labels with a picture (i.e., both picture-only and text+picture labels) were classified as pictorial labels, and labels with text only were classified as text labels. Due to the relatively small number of observations in the mixed response category, we could not conduct multinomial logistic regression. Two additional multivariable logistic regression analyses were conducted to examine factors associated with adaptive and maladaptive responses in current smokers who are the primary targets of warning labels. The above demographic variables, intention to quit, number of cigarettes per day, time to first cigarette, and type of message were included in the models as covariates.

We used ordinary least squares regression models to examine the relationships between the response categories and informativeness, denial, and negative emotions regarding the first label participants saw. Model diagnostics indicated that the data adequately met all the assumptions of the linear regression, except for a slight deviation from normality. However, a simulation study reported that deviation from normality is less of an issue in ordinary least squares regression when the sample size is large (500 or more) (Lumley, Diehr, Emerson, & Chen, 2002). Since our sample was 1,838, we proceeded with ordinary least squares regression models. The PROC GLM procedure in SAS was used to compare the adjusted means of perceived informativeness, denial, and negative emotions scores across the response categories in the total sample and by smoking status. All estimates were adjusted for demographic variables and type of label (pictorial vs. text), and smoking status was also adjusted for in the total sample estimates. Significance level was set a priori at $p < 0.05$.

Results

Characteristics of the Study Participants and the Distribution of the Four Response Categories

Table 1 shows samples of written responses about the warning labels and Table 2 displays participant characteristics and distribution of the four response categories. Overall, 61.8% were females, 79.9% were non-Hispanic White, and 45.1% were educated beyond high school.

Participants demonstrated adaptive (65.4%), maladaptive (16.5%), no (14.7%), and mixed (both adaptive and maladaptive; 3.4%) responses [$X^2 = 1674.4$, $DF = 3$, $p < 0.001$] in their written responses to health warning labels. Thus, H1 which stated that most of the message responses would be adaptive was supported, and there was a presence of a mixed response in the responses to the labels.

Individual Factors Associated with Adaptive and Maladaptive Responses in the Total Sample

RQ1 asked which individual factors are associated with maladaptive and adaptive responses. Compared to current smokers, non-smokers ($OR = 1.50$, 95% confidence interval (CI) = 1.18 – 1.91) and transitioning smokers ($OR = 1.59$, 95% CI = 1.22 – 2.06) had increased odds of adaptive responses. Odds of maladaptive response among non-smokers and transitioning smokers were reduced but were not significantly different from the odds among current smokers, adjusting for all other variables in the model ($p = 0.05$ and $p = 0.10$, respectively). Independent of smoking status and other demographic factors, participants aged 18–24 years had decreased odds of adaptive ($OR = 0.60$, 95% CI = 0.38 – 0.95) and increased odds of maladaptive ($OR = 1.72$, 95% CI = 1.02 – 2.91) responses, compared to those who were 65+ years old. Participants with high school or less education had lower odds of maladaptive response than those with bachelor's degree or higher education ($OR = 0.71$, 95% CI = 0.51 – 0.99). Compared to text-only warnings, pictorial labels were associated with increased odds of adaptive response ($OR = 1.27$, 95% CI = 1.03 – 1.56) and decreased odds of maladaptive response ($OR = 0.69$, 95% CI = 0.54 – 0.87) (Table 3).

Individual Factors Associated with Adaptive and Maladaptive Responses among Current Smokers

The odds of adaptive response in smokers with the intention to quit in the next 6 months (OR=1.90, 95% CI=1.17 – 3.09) and someday (OR=2.06, 95% CI=1.23 – 3.47) were significantly greater than the odds in smokers with no intention to quit. While the type of label was not associated with adaptive response ($p=0.52$), the odds of maladaptive response were significantly decreased in smokers who saw pictorial labels (OR=0.63, 95% CI=0.42 – 0.96) compared to those who saw text-only warnings (see Table 4).

Relationship between Message Response Categories and Perceived Informativeness, Denial, and Negative Emotions

Table 5 illustrates the marginal means of perceived informativeness, denial, and negative emotions by response categories.

Perceived informativeness—Consistent with H2, adaptive respondents had the highest perceived informativeness scores (adjusted mean (aM)=6.83) but were similar to those of the mixed respondents (aM=6.5). Those who showed maladaptive response rated the labels as significantly less informative (aM=5.35) than other respondents. Informativeness ratings in those who showed mixed response did not differ from those who showed no response ($ps<0.05$).

Denial—H3 was not supported. Denial in the maladaptive group (aM=3.11) was not significantly different from the adaptive and mixed response groups, and denial in the no response group was significantly higher (aM=3.84) than in the other three response categories.

Negative Emotions—Contrary to H4 that predicted the highest levels of negative emotions would be among participants with maladaptive responses, the overall negative emotion score was highest for adaptive response (aM=5.25), and lowest among maladaptive respondents (aM=3.57). We further evaluated the relationships between individual negative emotions and response categories and found an essentially similar pattern. Among the six negative emotions, “sad” had the highest score (see Supplementary Table 1).

Discussion

The EPPM postulates that exposure to fear appeals, such as cigarette warning labels, elicits one of three responses: no response, adaptive (danger control) response, or maladaptive (fear control) response. Heeding the calls to assess the extent to which these responses organically emerge from the audience (Abril et al., 2017; Maloney et al., 2011), in this study, we found that after seeing diverse cigarette warning labels, smokers and non-smokers freely reported all three categories of response, with the largest category, at 65%, being the adaptive response, followed by no response (17%) and maladaptive response (15%). In addition, a fourth response category, mixed response, emerged from the verbal reactions to the warning labels. Proportions of the mixed response were small (around 3%), but similar across non-smokers, current smokers, and transitioning smokers. The EPPM treats adaptive and

maladaptive responses as mutually exclusive (Witte & Allen, 2000), yet our study shows that a small proportion of participants exhibited both adaptive and maladaptive responses.

A closer look at the written responses revealed a variety of ambivalent attitudes towards smoking or cigarette warnings that accounted for this mixed response. Many smokers in this group believed that the message was true, but they had no intention to quit. Because intention has been postulated to be the immediate antecedent of behavior (Ajzen & Fishbein, 1974), and attitude is a predictor of behavior when the correlation between intention and behavior is high (Ajzen & Fishbein, 1977), the mixed responses suggest that, while fear appeals might produce cognitions in line with message recommendations, behavioral change may not occur due to lack of efficacy or perceptions of addiction. This is similar to mixed findings of other studies that found an adaptive response for some, but not other, outcomes. For example, Wong & Cappella (2009) found positive effect of fear appeals on intentions to seek help with quitting smoking, but not on actual intentions to quit smoking. Thus, while individuals may agree with the message, their personal situations may lead to mixed feelings and responses about the fear appeal. Perhaps previous knowledge of the threat, in the face of addiction or unwillingness to give up lead some people to express mixed response to warning labels. This brings up another issue that was excluded from the EPPM's original theorizing (Witte, 1992), but has since been raised by researchers (Muthusamy, Levine, & Weber, 2009; Nabi, Roskos-Ewoldsen, & Dillman Carpentier, 2008), specifically, the role of pre-existing threat and fear. Emerging research on the effects of repeated exposure to health messages and resultant message fatigue/wear-out shows that audiences' prior exposure to a class of messages may influence their processing of another similar incoming message (Borland et al., 2009; So, Kim, & Cohen, 2017). This is a particularly important issue to address in the context of anti-tobacco communications.

Anti-tobacco messages are wide-spread in the US, with approximately half a billion dollars spent annually on anti-tobacco advertising (Tobacco-Free Kids, 2016). Thus, people have at least some awareness of the threat of smoking. Given the role of pre-existing fear as raised by previous studies (Muthusamy et al., 2009; Nabi et al., 2008), the threat from anti-tobacco messages will be particularly salient to smokers, and many are already likely to be engaging in fear control responses (Netemeyer, Burton, Andrews, & Kees, 2016). Contrary to our hypothesis derived from the EPPM, maladaptive respondents reported lower negative emotions, including fear and worry, in response to warnings than adaptive respondents. Possibly, participants who exhibited maladaptive response had already been engaging in defensive responses that effectively controlled their levels of fear and negative emotions and, as a result, did not report much fear when exposed to fear appeals in the form of warning labels.

Likewise, our hypothesis that participants exhibiting maladaptive response would have the highest levels of denial was not supported. Instead, denial was greatest in the "no response" category and did not differ significantly among the other groups. Denial is an attempt to reduce fear from a threatening message. Participants who exhibited "no response" reported the second-highest levels of negative emotions (including fear) following the adaptive group. Possibly, the participants who explicitly reported that they had "no thoughts" actually had negative responses but chose not to report them because they did not want to elaborate on

them, which is avoidance, a maladaptive response. It should also be noted that denial was low across all groups (2.81–3.84 on a 9-point scale), suggesting that these messages were not perceived as exaggerated or misleading, regardless of how participants reacted to them.

Non-smokers and transitioning smokers were more likely to demonstrate adaptive response than current smokers. Adaptive respondents also had the highest rating score for informativeness of the warning labels, indicating positive attitudes towards the labels. Perceived threat and efficacy have been offered as the underlying motivation for an adaptive response or maladaptive response to fear appeals (Allahverdipour et al., 2007; Witte, 1992; Witte, Berkowitz, Cameron, & McKeon, 1998). While our study did not assess self-efficacy, the increased odds of adaptive response among transitioning smokers suggests that self-efficacy may play a role. This is because transitioning smokers in this study were smokers who had recently quit or were in the process of quitting and therefore may have increased belief in their ability to quit smoking (self-efficacy).

In their analysis of tweets about anti-smoking campaigns, Emery et al. (2014) found that 87%, 7% and 6% of the tweets were message acceptance, message rejection, and message disregard, respectively. Our adaptive response rate (68%) is lower than the 87% acceptance rate observed by Emery et al. Unlike our study in which maximum confidentiality was assured, Twitter users know that their responses are public, thereby increasing the chances of social desirability bias (Fisher, 1993), which may explain their higher acceptance rate. On the other hand, Twitter might capture responses from people who have strong emotions – enough to motivate them to express their opinions in the social media. In contrast, our study might have prompted responses from both people with strong emotions and those who did not have strong feelings or were more ambivalent, thus revealing a novel mixed response category.

Our study contributes to the growing literature on the superiority of pictorial warning labels compared to text-only warning labels (Noar, Francis, et al., 2016; Noar, Hall, et al., 2016). Past studies have found that pictorial warnings are perceived as more effective and are associated with increased knowledge of the health harms of smoking, decreased positive attitudes towards smoking, and increased intentions to quit and actual attempts to quit (Noar, Francis, et al., 2016; Noar, Hall, et al., 2016), all of which are adaptive responses. Our finding that participants were more likely to provide an adaptive response after seeing pictorial rather than text-only warnings is in line with past findings. We also found that pictorial warnings were associated with reduced odds of maladaptive response compared to text-only warnings. This is in contrast with past studies that found that pictorial warnings elicited greater reactance in smokers (Erceg-Hurn & Steed, 2011; Nonnemaker et al., 2010). However, these studies specifically measured reactance as negative emotional arousal, while in our study the participants freely expressed their thoughts about the messages, thereby incorporating both cognition and emotion in the message responses. Our findings of greater adaptive and less maladaptive responses for pictorial warnings, compared to text-only warning labels, provide further evidence for the FDA to implement pictorial warning labels on cigarette packs as mandated by the Family Smoking Prevention and Tobacco Control Act.

In interpreting the results, readers should be aware that current smokers were intentionally oversampled for this study, which explains the high smoking prevalence in our sample. The results may not apply to long-term former smokers because we did not include long-term former smokers; however, long-term former smokers typically resemble non-smokers in their responses to anti-tobacco messages. This study did not evaluate congruency between the text and pictures on the labels. Among the 9 FDA labels, some were more congruent than others, resulting in better recall of the content of the labels (Lochbuehler et al., 2018). Future research should investigate how congruency between text and pictures might affect adaptive and maladaptive responses to the warnings. This study also focused only on verbal reactions and did not measure major variables (perceived severity, perceived susceptibility, response efficacy, self-efficacy) involved in the process leading to these responses (Witte, 1992). Future studies should measure these variables and explore how they interact to produce the responses. Similarly, we measured only one defensive response – denial. However, other defensive responses should be measured, such as defensive avoidance, reactance (Witte, 1992), and possibly, cognitive reappraisal (van 't Riet & Ruiter, 2013) and suppression of threatening thoughts and emotions (Gross, 2002). Further, although the study sample was diverse with heterogeneous demographics, it was a non-probability sample which limits the generalizability of the findings. Although our study did not directly link EPPM reactions to actual behavior, it linked them to the outcomes that past research found to be precursors of behavior, such as behavioral intentions (Ajzen, 1985; Holzel et al., 2011; Webb & Sheeran, 2006).

Implications and conclusion

In participants' verbal reactions to cigarette warnings, adaptive responses were significantly more frequent than all other responses, irrespective of smoking status, and maladaptive response in smokers was not significantly related to intentions to quit smoking. Pictorial warning labels elicited more adaptive and fewer maladaptive responses compared to text-only warnings. Given the more frequent adaptive responses than maladaptive responses and the fact that maladaptive responses were not related to intentions to quit smoking, the findings of this study support the evidence that fear appeals show positive effects and do not backfire (Tannenbaum et al., 2015), confirming that fear appeals are an appropriate anti-smoking intervention. Thus, their use in anti-tobacco messaging continues to be supported.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1:
Samples of text and pictorial warning labels shown to participants

Table 1:

Samples of participants' written responses about the health warning labels

Response category	Subtype	Examples	Proportions of the subtypes (%) in the total sample ^{<i>β</i>}
No response (16.5%))		"No thoughts", "Nothing came to mind"	
Adaptive (68.8% ^{<i>α</i>})	Attitudes	"Smoking is bad for your health", "You have to be crazy to smoke"	57.6
	Behavioral intentions	"Would like to quit", "Made me feel very unsure about the product. I would turn away from it if I saw it at the store"	2.8
	Behavior	"I thought about how lucky I am that I have never smoked cigarettes", "Thought of my grandchild. I don't smoke around him"	2.7
Maladaptive (18.1% ^{<i>α</i>})	Message effectiveness	"Bold and decisive statement", "very impacted"	11.0
	Manipulative intent	"propaganda scare tactics using a baby", "Government lies to make smokers quit"	1.09
	Message ineffectiveness	"stupid, I think that was really dumb", "not really effective"	5.9
	Denial of susceptibility	"it's sad but it'll never happen to me", "this won't happen to me"	0.7
	Counterargument	"not everyone who smokes gets lung cancer", "she was probably more susceptible to the dangers of tobacco"	4.5
Mixed response (3.4%)		"truthful but annoying because I believe it but am not ready to quit right now", "good information but I am not interested in quitting at this time"	

^{*α*} NB: Includes mixed responses;

^{*β*} proportions are not mutually exclusive, e.g. a response may contain both behavior and behavioral intentions

Table 2:
Participant characteristics and distribution of message response categories (N=1838)

Variable	Total % (n)	No response % (n)	P-value	Adaptive % (n)	P-value	Maladaptive % (n)	P-value	Mixed response % (n)	P-value
Smoking status			<0.01		<0.01		0.02		0.21
Non-smokers	41.6 (764)	37.8 (115)		43.3 (520)		37.8 (102)		43.6 (27)	
Transitioning smokers	27.5 (505)	23.4 (71)		29.0 (349)		25.6 (69)		25.8 (16)	
Current smokers	31.0 (569)	38.8 (118)		27.7 (333)		36.7 (99)		30.7 (19)	
Gender			0.14		<0.01		0.01		0.02
Male	38.3 (703)	45.7 (139)		35.8 (430)		41.5 (112)		35.5 (22)	
Female	61.8 (1135)	54.3 (165)		64.2 (772)		58.5 (158)		64.5 (40)	
Age			<0.01		<0.01		<0.01		<0.01
<25 years	6.9 (126)	7.6 (23)		6.2 (74)		8.5 (23)		9.7 (6)	
25–44 years	37.3 (686)	39.5 (120)		37.4 (449)		35.2 (95)		35.5 (22)	
45–64 years	38.6 (710)	38.2 (116)		38.2 (459)		41.5 (112)		37.1 (23)	
65+ years	17.2 (316)	14.8 (45)		18.3 (220)		14.8 (40)		17.7 (11)	
Race			<0.01		<0.01		<0.01		<0.01
White	79.9 (1469)	79.9 (243)		79.3 (953)		83.0 (224)		79.0 (49)	
Other race	20.1 (369)	20.1 (61)		20.7 (249)		17.0 (46)		21.0 (13)	
Education			<0.01		<0.01		<0.01		0.03
High school or less	23.2 (427)	23.7 (72)		24.2 (291)		19.6 (53)		17.7 (11)	
Some College	31.7 (583)	30.9 (94)		31.1 (374)		33.0 (89)		41.9 (26)	
Bachelor's degree or higher	45.1 (828)	45.4 (138)		44.7 (537)		47.4 (128)		40.3 (25)	
First label seen			<0.01		<0.01		0.22		0.61
Text-only		40.2 (121)		36.9 (443)		46.3 (125)		46.8 (29)	
Pictorial		59.8 (180)		63.1 (759)		53.7 (145)		53.2 (33)	
Total	100.0 (1838)	16.5 (304)		65.4 (1202)		14.7 (270)		3.4 (62)	

P-values were derived from chi-square tests that compared categories of each demographic factor and smoking status in each of the four response categories

Table 3:

Correlates of adaptive and maladaptive responses in the total sample (N=1838)

Effect	Odds Ratio	95% Confidence Limits	P-value
Adaptive response			
Non-smoker vs current smoker	1.50	1.18 – 1.91	<0.01
Transitioning smoker vs current smoker	1.59	1.22 – 2.06	<0.01
Female vs Male	1.36	1.10 – 1.67	<0.01
<25 years vs 65+ years	0.60	0.38 – 0.95	0.03
25–44 years vs 65+ years	0.85	0.63 – 1.16	0.32
45–64 years vs 65+ years	0.78	0.58 – 1.05	0.10
White vs other race	1.23	0.95 – 1.59	0.12
High school or less vs bachelor's degree or higher	1.18	0.90 – 1.54	0.22
Some college vs bachelor's degree or higher	1.01	0.79 – 1.28	0.95
Pictorial warning label vs. text-only warning label	1.27	1.03 – 1.56	0.02
Maladaptive response			
Non-smoker vs current smoker	0.75	0.57 – 1.00	0.05
Transitioning smoker vs current smoker	0.77	0.56 – 1.05	0.10
Female vs Male	0.93	0.72 – 1.19	0.54
<25 years vs 65+ years	1.72	1.02 – 2.91	0.04
25–44 years vs 65+ years	1.04	0.72 – 1.51	0.84
45–64 years vs 65+ years	1.22	0.85 – 1.74	0.28
White vs other race	0.78	0.57 – 1.07	0.13
High school or less vs bachelor's degree or higher	0.71	0.51 – 0.99	0.04
Some college vs bachelor's degree or higher	1.07	0.81 – 1.41	0.64
Pictorial warning label vs. text-only warning label	0.69	0.54 – 0.87	<0.01

Estimates were derived from two multivariable logistic regression analyses (one for adaptive response and one for maladaptive response).

Table 4:

Correlates of adaptive and maladaptive responses in current smokers (N=569)

Effect	Odds ratio	95% Confidence Limits	P-value
Adaptive Response			
Intention to quit within 6 months vs Never intend to quit	1.90	1.17 – 3.09	<0.01
Intention to quit someday vs Never intend to quit	2.06	1.23 – 3.47	<0.01
First smoke after 30 min vs within 30 min	0.87	0.60 – 1.26	0.44
<20 cigs per day vs 20 cigs per day	1.31	0.86 – 1.98	0.21
Female vs Male	1.32	0.93 – 1.89	0.12
<25 years vs 65+ years	1.21	0.51 – 2.91	0.67
25–44 years vs 65+ years	0.92	0.52 – 1.63	0.77
45–64 years vs 65+ years	0.82	0.46 – 1.45	0.49
White vs other race	1.37	0.88 – 2.12	0.16
High school or less vs bachelor's degree or higher	0.85	0.55 – 1.31	0.46
Some college vs bachelor's degree or higher	0.99	0.64 – 1.52	0.95
Pictorial warning label vs. text-only warning label	1.12	0.79 – 1.60	0.52
Maladaptive Response			
Intention to quit within 6 months vs Never intend to quit	0.73	0.42 – 1.27	0.26
Intention to quit someday vs Never intend to quit	0.58	0.31 – 1.06	0.08
First smoke after 30 min vs within 30 min	1.31	0.84 – 2.06	0.23
<20 cigs per day vs 20 cigs per day	1.26	0.78 – 2.04	0.34
Female vs Male	0.80	0.52 – 1.22	0.30
<25 years vs 65+ years	0.51	0.18 – 1.46	0.21
25–44 years vs 65+ years	0.56	0.30 – 1.06	0.08
45–64 years vs 65+ years	0.75	0.40 – 1.39	0.36
White vs other race	0.78	0.45 – 1.34	0.37
High school or less vs bachelor's degree or higher	1.05	0.62 – 1.80	0.85
Some college vs bachelor's degree or higher	1.44	0.87 – 2.39	0.16
Pictorial warning label vs. text-only warning label	0.63	0.42 – 0.96	0.03

Estimates were derived from two multivariable logistic regression analyses (one for adaptive response and one for maladaptive response).

Table 5:

Marginal means of perceived informativeness, denial and negative emotions by message response categories (N=1838)

Effect	No response LSM (95% CI)	Adaptive LSM (95% CI)	Maladaptive LSM (95% CI)	Mixed response LSM (95% CI)
<i>Perceived Informativeness</i>				
Overall	6.12 (5.86–6.38) ^a	6.83 (6.68–6.99)^b	5.35 (5.08–5.63) ^c	6.5 (5.96–7.05) ^{ab}
Non-smokers	5.84 (5.42–6.25) ^a	6.67 (6.43–6.91) ^b	5.71 (5.27–6.16) ^a	6.81 (5.98–7.64)^b
Transitioning smokers	6.39 (5.85–6.93) ^a	7.11 (6.80–7.42)^b	5.58 (5.03–6.13) ^c	6.49 (5.42–7.55) ^{abc}
Current smokers	6.05 (5.62–6.49) ^a	6.72 (6.43–7.01)^b	4.81 (4.35–5.27) ^c	6.02 (5.04–7.01) ^{ab}
<i>Denial</i>				
Overall	3.84 (3.57–4.12)^a	3.35 (3.18–3.51) ^b	3.11 (2.82–3.40) ^b	2.81 (2.23–3.38) ^b
Non-smokers	3.02 (2.64–3.40)^a	2.73 (2.51–2.95) ^{ab}	2.37 (1.96–2.77) ^{ab}	2.36 (1.60–3.12) ^b
Transitioning smokers	3.93 (3.32–4.54)^a	3.50 (3.14–3.85) ^{ab}	3.29 (2.66–3.91) ^b	3.00 (1.79–4.20) ^{ab}
Current smokers	4.48 (3.99–4.98)^a	3.75 (3.42–4.07) ^a	3.77 (3.25–4.30) ^a	3.23 (2.11–4.35) ^a
<i>Negative Emotions</i>				
Overall	4.61 (4.32–4.91) ^a	5.25 (5.07–5.43)^b	3.57 (3.26–3.89) ^c	4.10 (3.48–4.72) ^{ac}
Non-smokers	3.68 (3.24–4.12) ^a	4.25 (3.99–4.50)^b	3.24 (2.77–3.71) ^a	3.76 (2.88–4.65) ^{ab}
Transitioning smokers	5.17 (4.52–5.82) ^a	5.88 (5.50–6.25)^b	3.69 (3.02–4.35) ^c	4.08 (2.80–5.35) ^{ac}
Current smokers	4.78 (4.27–5.28) ^a	5.53 (5.19–5.86)^b	3.65 (3.12–4.18) ^c	4.19 (3.06–5.33) ^{ac}

Note: Bold means highest score. LSM, Least squares means; CI, Confidence intervals. Estimates are from PROC MIXED models in SAS. All estimates were adjusted for sex, age, race, educational level, and type of message. Smoking status was also adjusted for in the overall estimates. Estimates with the different superscripts in each row are significantly different (p<0.05)