Published in final edited form as:

Health Educ Behav. 2019 June ; 46(3): 471–483. doi:10.1177/1090198118825236.

Feeling Hopeful Motivates Change: Emotional Responses to Messages Communicating Comparative Risk of Electronic Cigarettes and Combusted Cigarettes

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Abstract

Background: Emotions are important in smoking-related communications, but the role of discrete positive and negative emotions in comparative risk messages about combusted and electronic cigarettes (e-cigarettes) is unclear.

Method: In an online experiment, 1,202 U.S. adult current smokers or recent quitters were randomized to view one of six messages about comparative risk of e-cigarettes and cigarettes. Participants reported their feelings of hope, happiness, fear, guilt, disgust, and anger and risk perceptions and behavioral intentions about e-cigarettes and cigarettes.

Results: Hope was associated with higher perceived absolute cigarette risk, lower perceived absolute and comparative e-cigarette risk, stronger intentions to quit smoking, seek quit help, use nicotine replacement therapy (NRT), switch to e-cigarettes, and use e-cigarettes exclusively versus dual use. Happiness was related to stronger intentions to seek quit help, use NRT, and switch to e-cigarettes but higher perceived comparative risk of e-cigarettes. Fear was associated with stronger intentions to quit smoking, seek quit help, use NRT, and switch to e-cigarettes. Guilt was related to higher perceived absolute cigarette risk, lower perceived comparative e-cigarette risk, and stronger intentions to use NRT. Disgust was associated with higher absolute and comparative e-cigarette risk and stronger intentions to quit smoking, seek quit help, and use e-cigarettes exclusively versus dual use. Anger was related to lower perceived absolute cigarette risk, higher perceived comparative e-cigarette risk, and weaker intentions to quit smoking.

Conclusion: Comparative risk messages about e-cigarettes that arouse hope, fear, and guilt and avoid anger might be particularly likely to have positive impact on smokers.

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The authors declare that there is no conflict of interest.

Keywords

electronic cigarettes; cigarettes; emotion; comparative risk communication; hope

Introduction

Electronic cigarettes (e-cigarettes) are battery-powered devices that heat a liquid solution of propylene glycol and/or vegetable glycerin, nicotine, and flavors into an aerosol for users to inhale. From 2014 to 2016, ever use of e-cigarettes increased from 12.6% to 15.3% among U.S. adults 18 years and older (Schoenborn & Clarke, 2017; Schoenborn & Gindi, 2015). E-cigarettes aerosol is not harmless. It generally contains nicotine, heavy metals, flavorings, and cancer-causing chemicals (Goniewicz et al., 2014). However, e-cigarettes contain lower levels of harmful chemicals than combusted cigarettes (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018). Hence, e-cigarettes may be promoted as a less harmful alternative to combusted cigarettes under the rules set by the U.S. Food and Drug Administration (FDA) (FDA, 2012).

In the U.S., e-cigarettes are regulated by the FDA as tobacco products (FDA, 2016). The FDA (2012) allows tobacco companies to apply for permissions to market their products as a less harmful alternative to tobacco products currently on the market by filing a modified risk tobacco product (MRTP) application. In the application, tobacco companies need to provide sufficient evidence that their products and modified risk marketing claims will have population-level benefits (FDA, 2012). As of December 2018, several MRTP applications have been filed for smokeless and heated tobacco products (General Snus, Camel Snus, IQOS heated tobacco product, and Copenhagen Snuff Fine Cut) (FDA, 2017, 2018a, 2018b, 2018c). FDA has not yet granted any MRTP authorization. No MRTP application has been submitted for e-cigarettes. However, e-cigarettes are one of the most popular non-combusted tobacco products in the U.S. (Kasza et al., 2017) and future e-cigarette MRTP applications are likely forthcoming. Thus, it is important to understand the effects of communication about the risk differences between combusted and electronic cigarettes.

Recent research started examining messages about comparative risk of combusted and e-cigarettes. Studies found that people exposed to comparative risk messages reported lower perceived comparative risk of e-cigarettes (Berry, Burton, & Howlett, 2017; Pepper, Byron, Ribisl, & Brewer, 2017; Wackowski, Hammond, O'Connor, Strasser, & Delnevo, 2016; Yang, Owusu, & Popova, 2018), greater intentions to switch completely to e-cigarettes (Yang et al., 2018), weaker intentions to smoke (Yang et al., 2018), and less smoking behaviors (Jo, Golden, Noar, Rini, & Ribisl, 2018). Nevertheless, some studies indicated that comparative risk messages about e-cigarettes had no effects on smoking cessation intentions (Jo et al., 2018; Yang et al., 2018) and increased dual use interest (Pepper et al., 2017). Hence, comparative risk messages about e-cigarettes may have unintended consequences. When evaluating MRTP applications, FDA needs to assure modified risk claims have population-level benefits (FDA, 2012). Therefore, beyond examining the effects of comparative risk messages, it is important to comprehend what factors in comparative risk communication are associated with more intended (e.g., intentions to switch completely to e-

cigarettes) and less unintended (e.g., dual use intentions) outcomes. These factors can be harnessed to design comparative risk messages (e.g., modified risk claims) that can benefit population health. However, this issue has received very limited attention, with studies focusing primarily on people's cognitive responses to comparative risk messages (e.g., Berry et al., 2017; Pepper et al., 2017). Emotion is another determining factor in health decision-making (Ferrer, Klein, Lerner, Reyna, & Keltner, 2014) and has been identified as one of the central mechanisms through which both tobacco advertisements and antitobacco educational messages influence consumers (Hammond, 2011; Padon, Maloney, & Cappella, 2017). Therefore, understanding the role of emotion in responses to comparative risk messages about e-cigarettes is necessary.

Emotion, Risk Perception, and Behavior

Emotions are conceptualized as evaluative and valenced mental states that evolved to help humans navigate threats and opportunities in their surroundings and social living (Horberg, Oveis, & Keltner, 2011; Nabi, 2002; Ortony, Clore, & Collins, 1990). Emotions have long been acknowledged as powerful drivers of human perceptions and decision-making (Johnson & Tversky, 1983; Mayer, Gaschke, Braverman, & Evans, 1992; Wright & Bower, 1992).

To study emotions in human decision-making, many studies use a valence-based approach, distinguishing between positive and negative emotions as two broad affective dimensions (Forgas, 2003; Han, Lerner, & Keltner, 2007; Nabi, 2002). However, valence-based approach cannot explain why same-valence emotions sometimes lead to different judgments and behavioral outcomes (Barrett, 2006; Lerner, Gonzalez, Small, & Fischhoff, 2003). To address this discrepancy, scholars proposed a discrete emotion approach (Dillard & Peck, 2001; Izard & Ackerman, 2000; Lerner & Keltner, 2000), which provided a more nuanced understanding of the role of emotions in decision-making (Dillard & Peck, 2001; Lerner & Keltner, 2001; Popova, So, et al., 2017).

According to Lerner and Keltner's (2000) *appraisal-tendency framework* (ATF), each emotion carries a unique underlying cognitive and motivational property that fuels differential cognitive predispositions toward appraisals of future events (i.e., appraisal tendencies). Such appraisal of future events will be consistent with the appraisal dimensions that define an emotion. Scholars (Smith & Ellsworth, 1985) have identified six key appraisal themes for a particular emotion, including pleasantness, anticipated effort, attention activity, certainty, control, and responsibility. Emotions that differ on a particular dimension are expected to produce different judgements about an issue related to the appraisal dimension. For instance, fear and anger differ on the appraisal dimensions of certainty and control: fear is associated with a sense of uncertainty and lack of individual control whereas anger is associated with a sense of certainty and the perception of individual control. Certainty and control are similar to the "cognitive meta-factors" that shape people's decision-making about a risk (Lerner & Keltner, 2001, p. 3). Greater risk perception arises from a sense of uncertainty and lack of individual control. As a result, fear should be positively whereas anger should be negatively associated with perceived risk. Using the ATF, many studies demonstrated that different emotions, either as people's dispositional or situationally induced feelings, could have different relationships with risk perceptions (Lerner et al.,

2003; Lerner & Keltner, 2000, 2001; Lerner, Li, Valdesolo, & Kassam, 2015). Additionally, using the ATF, studies found that discrete emotions are associated with different risk-related decision-making or behavioral tendencies. For instance, angry participants preferred a risky option to cure a disease whereas fearful participants preferred a sure option (Lerner & Keltner, 2001). Yang and Chu (2016) found that different negative emotions assessed following Ebola risk messages were differentially correlated with people's support for institutional efforts to mitigate Ebola risk and people's personal willingness to engage in the risk mitigation efforts.

The Present Study

To our knowledge, only one study has examined the role of discrete emotions in comparative risk communication about e-cigarettes (Popova, So, et al., 2017). However, the study did not separate the comparative risk message from other messages (e.g., warning messages) when testing emotion-behavioral intention relationship. Hence, the role of emotions in the persuasive effects of comparative risk communication remains unclear. Also, the study examined the relationship between discrete emotions and openness to use tobacco products but did not examine the relationship between various emotions and risk perceptions. While assessing MRTP claims from tobacco companies, FDA considers both the behavioral and the cognitive impacts of the claims, particularly consumers' comparative risk perception about the modified risk tobacco products (FDA, 2012). To better inform FDA regulatory decision making, it is important to examine how various positive and negative emotions induced by comparative risk messages are related to both behavioral intentions and risk perceptions.

In this study, we examined the association of discrete emotions (anger, fear, disgust, guilt, happiness, and hope) aroused by comparative risk messages with cognitive and behavioral intention responses to the messages. We used ATF to guide our hypotheses. As aforementioned, the ATF proposes that different emotions may lead to different decisions based on their appraisal themes relevant to the decision making. Among the six important appraisal themes of emotions (Smith & Ellsworth, 1985), certainty and control are the most relevant themes to the judgement about risk (Lerner & Keltner, 2001). Past studies found that anger and happiness were associated with perceptions of certainty and individual control—predictors of low risk perception and risk-seeking tendencies (Lerner & Keltner, 2001; Smith & Ellsworth, 1985). By contrast, fear and hope were associated with perceptions of uncertainty and lack of individual control—predictors of high risk perception and risk-averse tendencies (Smith & Ellsworth, 1985). As a result, anger and happiness should be negatively associated with perceived risks and intentions to avert a risk whereas positive relationships are expected for fear and hope. Such expectations have been empirically demonstrated (Hammond, 2011; Lerner & Keltner, 2000, 2001; Popova, So, et al., 2017; Sheeran & Taylor, 1999).

In prior ATF studies on the relationship between message induced emotions and risk perceptions (Lerner et al., 2003; Yang & Chu, 2016), the risk usually refers to a risk behavior depicted in a message. In the context of comparative risk communication, the risk behavior depicted in the message is the use of combusted cigarettes. Therefore, the expected

relationships between different emotions and risk perceptions and behavioral intentions apply to the combusted cigarettes. Specifically:

H1: Fear and hope are positively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use nicotine replacement therapy.

H2: Anger and happiness are negatively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use nicotine replacement therapy.

Disgust and guilt are also related to certainty and individual control (Smith & Ellsworth, 1985). However, both emotions are rated lower than happiness on the dimension of certainty and lower than anger on the dimension of individual control (Smith & Ellsworth, 1985). More importantly, guilt is linked to a strong sense of personal responsibility to correct a problem and disgust is associated with a strong tendency to move away from an unpleasant object (Han et al., 2007; So et al., 2015). Thus, guilt and disgust may still be related to beliefs and tendencies to stay away from a risk and these have been shown in multiple empirical studies (Clayton, Leshner, Tomko, Trull, & Piasecki, 2017; Kim & Kwon, 2017; Popova et al., 2018; Xu & Guo, 2018). As a result, we predict:

H3: Guilt and disgust are positively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use nicotine replacement therapy.

No studies have examined how discrete emotions induced by a risk message are associated with the perceived risk of a promoted behavior, that is, using e-cigarette in the context of e-cigarette comparative risk communication. Therefore, we ask:

RQ1: How are fear, guilt, disgust, anger, happiness, and hope related to a) perceived absolute risk of e-cigarettes, b) comparative risk of e-cigarettes, c) intentions to switch completely to e-cigarettes, and d) intentions to use both combusted and e-cigarettes (dual use intentions)?

Method

Design

This study was part of a large research project examining smokers' responses to messages communicating about the comparative risks of e-cigarettes and combusted cigarettes. Detailed message development process has been reported elsewhere (Yang et al., 2018). Briefly, we developed six comparative risk messages based on our team's expertise in tobacco control, review of existing educational e-cigarette messages and studies about e-cigarette comparative risks, and focus group discussions.

All six messages stated that e-cigarettes are less harmful than combusted cigarettes (see Appendix 1 for messages). Three comparative risk messages (hereinafter referred as CR messages) resembled e-cigarette advertisements and the modified risk claims proposed by

tobacco companies. They were constructed more positively, focusing on the benefits of e-cigarettes relative to cigarettes. In contrast, three other messages (hereinafter referred as CR-messages) focused on promoting smoking cessation but emphasizing e-cigarettes might be a less harmful alternative if people cannot quit for good. CR- messages were framed more negatively. As a result, CR and CR- messages bore resemblance to gain- (emphasis on benefits of not smoking) and loss-framed (emphasis on costs of continued smoking) antismoking messages. Prior studies have suggested that loss- and gain-framed messages could elicit different emotions with gain-framed messages inducing greater positive emotions and loss-framed messages inducing more negative emotions (Rothman, Salovey, Antone, Keough, & Martin, 1993; Schneider et al., 2001; Zhao, Nan, Yang, & Alexandra Iles, 2014). Similar to prior practice (Kang & Cappella, 2008; Nan, 2009), we used two sets of differently valenced comparative risk messages to arouse various negative and positive emotions.

Participants and Procedure

Participants were 1,400 adults aged 18 and over who were either current smokers (have smoked at least 100 cigarettes in their lifetime and were now smoking cigarettes some days or every day) or smokers who quit within the past two years. Participants were members of an online panel recruited by a market research company Toluna through different online recruitment strategies (e.g., web banners, website referrals, affiliate marketing, pay-per-click), a nonprobability sample. Each participant completed electronic informed consent. All protocols were approved by the Georgia State University IRB.

The study was an online experiment. Participants began by answering questions regarding basic demographics and the use and beliefs about e-cigarettes and cigarettes. Next, participants were randomized to view one of seven messages: three CR messages, three CR-messages, and a control message. Similar to past studies (Popova et al., 2016, Kim et al., 2017), the control group saw an advertisement for bottled water, a neutral message that was unlikely to affect perceptions or intentions to use e-cigarettes or cigarettes. Following message presentation, participants answered questions about their reactions to the messages and beliefs and intentions around e-cigarettes and cigarettes. When the study concluded, all participants saw a debriefing page stating that the messages were for research purposes only and that stopping smoking completely was the best thing smokers should do.

The purpose of this research is to examine how emotions induced by comparative risk messages are associated with smokers' e-cigarette- and cigarette-related risk perceptions and behavioral intentions. Hence, only participants ($N= 1,202$) who viewed the comparative messages were included into this study.

Key Measures

Key measures included discrete negative and positive emotions (Nonnemaker, Farrelly, Kamyab, Busey, & Mann, 2010; Popova, Owusu, et al., 2017; Popova, So, et al., 2017), perceived absolute cigarette and e-cigarette risk (Chaffee et al., 2015), perceived comparative risk of e-cigarettes (NASEM, 2018), intentions to quit smoking (Carpenter, Hughes, Solomon, & Callas, 2004), seek quit help, use nicotine replacement therapy (Wong

& Cappella, 2009), switch completely to e-cigarettes (Mays, Moran, Levy, & Niaura, 2015), and dual use intentions. Detailed measurements and descriptive statistics of key measures are shown in Table 1 and 2, respectively.

Analysis Plan

Analyses were performed in SPSS v24. We first examined the effects of message type on different emotions using analysis of covariance. For the primary analyses, we used multivariable hierarchical ordinary least square regressions for risk perceptions and behavioral intentions (continuous outcomes) and multivariable hierarchical multinomial logistic regressions for perceived comparative risk of e-cigarettes and dual use intentions (categorical variables). For both types of regressions, we used the same variable entry strategy: hierarchical with two blocks with message type (CR vs. CR-), e-cigarettes use (current vs. ever but not current vs. never), daily smoking (yes vs. no), quit attempt in the past 12 months (yes vs. no), sex (male vs. female), race (White vs. non-White), and education (no college degree vs. college degree) entered in Block 1 and the six discrete emotions entered in Block 2. In the multinomial logistic regression models, for perceived comparative risk, the dependent categories are less harmful (reference), equally or more harmful and “I don’t know”. For dual use intentions, the categories are exclusive e-cigarette use intentions, cessation intentions, and dual use intentions (reference). We also performed an additional analysis and examined whether current dual use (current dual users vs. everyone else) interacted with each emotion. The results are reported in the Appendix 2.

Results

Sample Characteristics and Message Effects on Emotions

Participants were 53.7% female and 82.4% White. About 36.4% had high school education or less, and 31.1% were current dual users of e-cigarettes and cigarettes (Table 3). CR-messages aroused higher levels of all negative emotions and lower levels of positive emotions compared to CR messages (Table 4).

Association of Emotions with Cigarettes Risk Perceptions and Intentions

H1 predicts that fear and hope are positively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use nicotine replacement therapy (NRT). According to Table 5, fear was not whereas hope was positively associated with perceived absolute combusted cigarettes risk ($b = 0.07, p < .001$). H1a was supported only for hope. Both fear and hope were positively associated with intentions to quit smoking (fear $b = 0.12, p = .02$; hope $b = 0.28, p < .001$), seek quit help (fear $b = 0.06, p < .001$; hope $b = 0.06, p < .001$) and to use NRT (fear $b = 0.04, p = .02$; hope $b = 0.07, p < .001$). H1b-d were supported.

H2 predicts that anger and happiness are negatively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use NRT. In Table 5, anger was negatively associated with perceived absolute combusted cigarette risk ($b = -0.05, p = .005$) and intentions to quit smoking ($b = -0.11, p = .02$). The relationships for happiness were not significant. H2a-b were only supported for

anger. Happiness ($b = 0.05, p < .001$) was positively associated with intentions to seek quit help and to use NRT ($b = 0.03, p = .02$). The relationships were not significant for anger. H2c-d were not supported.

H3 predicts that guilt and disgust are positively related to a) perceived absolute risk of combusted cigarettes, b) intentions to quit smoking, c) intentions to seek quit help, and d) intentions to use NRT. In Table 5, guilt ($b = 0.05, p < .001$) but not disgust was positively associated with perceived absolute combusted cigarettes risk. H3a was only supported for guilt. Disgust was positively associated with intentions to quit smoking ($b = 0.09, p < .05$) and seek quit help ($b = 0.04, p = .007$) but these were not found for guilt. H3b-c were only supported for disgust. Guilt ($b = 0.05, p < .001$) was positively associated with intentions to use NRT. The relationship was not significant for disgust. H2d was only supported for guilt.

Associations of Emotions with E-Cigarettes Risk Perceptions and Intentions

R1 explores how discrete emotions are associated with a) perceived absolute risk of e-cigarettes, b) comparative risk of e-cigarettes, c) intentions to switch completely to e-cigarettes, and d) intentions to use both combusted and e-cigarettes (dual use intentions). According to Table 6, for R1a, hope ($b = -0.07, p = .001$) was negatively and disgust ($b = 0.09, p < .001$) was positively associated with perceived absolute e-cigarette risk. For R1b, hope ($b = 0.28, p < .001$), happiness ($b = 0.15, p < .001$) and fear ($b = 0.10, p = .007$) were positively associated with intentions to switch completely to e-cigarettes. For R1c, higher hope (aOR = 0.83, $p < .001$) and guilt (aOR = 0.89, $p = .001$) were associated with lower odds of seeing e-cigarettes being equally or more harmful than combusted cigarettes. Higher happiness (aOR = 1.09, $p = .01$), disgust (aOR = 1.10, $p = .01$) and anger (aOR = 1.20, $p < .001$) were associated with higher odds of seeing e-cigarettes being equally or more harmful. Higher hope (aOR = 0.85, $p < .001$) was associated with lower odds of reporting “I don’t know” for comparative risk perception. For R1d, higher hope (aOR = 1.23, $p < .001$) and disgust (aOR = 1.15, $p = .02$) were associated with higher odds of intentions to use e-cigarettes exclusively compared to dual use.

Discussion

Emotions play a significant role in shaping people’s health-related beliefs and behaviors (Ferrer et al., 2014), particularly in the context of tobacco-related communication (Hammond, 2011; Padon et al., 2017). We evaluated how discrete emotions evoked by comparative risk messages about combusted and e-cigarettes are associated with perceptions of risk and behavioral intentions regarding e-cigarettes and cigarettes.

Among the six emotions we examined, hope, fear, and guilt were related to the intended outcomes of comparative risk communication (i.e., higher perceived combusted cigarette risk, lower perceived comparative risk of e-cigarettes than combusted cigarettes, higher quit intentions and switch intentions, and lower dual use intentions). Hope in particular was consistently associated with intended outcomes in terms of perceptions of both electronic and combusted cigarettes. The findings align with the proposition of the appraisal-tendency framework (ATF) that hope is related to the appraisals of uncertainty and lack of individual control (thus stronger risk-averse tendencies) (Smith & Ellsworth, 1985). Comparative risk

message should focus on increasing hope. Hope is evoked when a desirable outcome is possible but uncertain (MacInnis & De Mello, 2005; Rossiter & Percy, 1991). The comparative risk messages can present different levels of uncertainty – use of e-cigarettes “can” reduce your health risks (hypothetical language) or it “will” reduce your health risks (deterministic language). In our study, CR messages consistently used hypothetical language (i.e., “can reduce”) while CR- messages more categorically told the smokers to “switch to e-cigarettes completely and reduce your risks.” It is possible that the higher level of hope in the CR messages compared to CR- messages stemmed in part from the difference in the use of hope-evoking hypothetical language. The promotional materials submitted to the FDA as part of the MRTP applications so far have used the combination of hypothetical language (i.e., “can reduce the risks of tobacco-related diseases,” “can significantly reduce their risk”) and deterministic statements (“presents less risk of harm,” “no smoke=less risk”). Future research should explicitly evaluate the effects of hypothetical and deterministic comparative risk messages on emotions and intentional/behavioral outcomes.

Fear was associated with stronger intentions to quit smoking, seek quit help, use NRT, and switch to e-cigarettes. Fear seems to motivate intentions to perform specific behaviors that are viewed as effective in reducing the threat from smoking. The finding is consistent with the ATF proposition that fear is related to the appraisal of uncertainty and lack of individual control and thus stronger tendencies to stay away from a threat. Guilt was related to higher perceived absolute cigarettes risk, lower perceived comparative e-cigarettes risk, and higher intentions to use NRT. The finding is consistent with the proposition that guilt is linked to a strong tendency to correct a problem (Han et al., 2007; So et al., 2015). Both fear and guilt have been widely used in health-promoting messages, including antismoking campaigns (Hammond, Fong, McDonald, Brown, & Cameron, 2004; Xu & Guo, 2018). However, they do not seem to be the emotions comparative risk messages attempt to evoke. The modified risk claims submitted by tobacco companies emphasized the benefits of e-cigarettes over cigarettes similar to our CR messages, which as we have demonstrated would produce more positive than negative emotions. In our study, we found that guilt and fear were associated with some desirable outcomes (e.g., greater combusted cigarette risk perception and stronger quit intentions) even after we controlled for positive emotions. Hence, comparative tobacco risk communication may also want to appeal to guilt and fear by highlighting the negative health consequences of continued smoking.

Disgust was associated with greater intentions to quit smoking and seek quit help. Happiness was positively associated with intentions to seek quit help and use NRT. However, both disgust and happiness were associated with greater perceived comparative risk of e-cigarettes. These findings suggest that comparative risk messages being able to elicit disgust and happiness might be effective in encouraging smoking cessation but might not help shape correct comparative risk perception about e-cigarettes and combusted cigarettes. However, if the goal is to increase perceptions of risk of e-cigarettes (for example, among non-smoking youth), this might be a desired outcome. Future studies should evaluate the role of these emotions on non-smokers’ responses to comparative risk communications, particularly among youth.

Our finding that happiness was positively associated with quit-related intentions is inconsistent with the empirical evidence based on the ATF (Lerner & Keltner, 2001). In our study, we did not ask why people felt happy. Potentially, people felt happy because they learned they could use e-cigarettes to reduce their current health risk. As a result, they are more willing to follow the advice. More studies should be conducted to better understand the role of happiness in comparative risk communication.

Anger was associated with undesirable outcomes, such as lower perceived absolute cigarette risk, weaker intentions to quit smoking, and higher odds of perceiving e-cigarettes as being equally or more harmful than combusted cigarettes. The findings were consistent with the appraisal emphasis of anger on certainty and individual control. In tobacco communications, anger has been studied primarily as part of reactance (Erceg-Hurn & Steed, 2011; Noar et al., 2015), which occurs when a person perceives a threat to his or her personal freedom and is motivated to remove this threat (Brehm & Brehm, 1981). Similar to past research on reactance (Erceg-Hurn & Steed, 2011), we found that anger in comparative risk messages seems to be counterproductive and should be avoided.

Emotions have been used extensively in tobacco-related communications. While anti-tobacco campaigns have focused predominantly on negative emotions (Dunlop, Wakefield, & Kashima, 2008), tobacco companies have extensively used positive emotions to promote their products (Anderson, Pollay, & Ling, 2006; Pollay, 2000). Historically, when new information about the negative health effects of smoking came to light, tobacco companies initially countered it with advertisements highlighting new risk-reducing features of their products, such as filters or low levels of tar (Anderson et al., 2006; Anonymous, 1976). However, tobacco companies soon realized that these advertisements made risk perceptions more salient. Therefore, they switched from presenting comparative risk information to positive emotional appeals, portraying new products as sophisticated, sporty, and stylish (Pollay & Dewhirst, 2002). Today, the tobacco industry's MRTP applications seem to follow the same pattern. The early submissions from Swedish Match, Philip Morris International, and RJ Reynolds featured modified risk advertisements that focused predominantly on communicating lower risks of their modified risk products. Consumer studies that these companies submitted as part of their MRTP applications did not measure emotions that consumers felt in response to these advertisements. However, as we have demonstrated in this study, emotions are related to risk perception and intentions following comparative risk communication. MRTP applications should explicitly report the emotional reactions of consumers to these advertisements. Based on our findings, modified risk claims that evoke hope might be more likely to result in positive outcomes among current smokers and those that arouse anger should be avoided.

This study is limited by the cross-sectional measurement of emotions, risk perceptions and intentions. Our nonprobability sample was predominantly White and educated. We measured people's intentions instead of their actual behaviors although changing smokers' behaviors is the ultimate goal of antismoking communication. Finally, the dual use intentions measure was developed for this study and has not been validated.

The FDA and other agencies are examining ways to communicate about potentially reduced risk products including e-cigarettes in such a way that would increase population-level benefits (e.g., by making smokers switch completely to e-cigarettes) and reduce negative outcomes (such as relapse in former smokers or tobacco initiation by non-users) (Gottlieb & Zeller, 2017). Our study informs these regulatory efforts by demonstrating that messages focused on eliciting hope, fear, and guilt and avoiding anger might be a promising strategy for comparative risk communication about modified risk tobacco products.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work is supported by the National Institute of Drug Abuse of the National Institutes of Health and Food and Drug Administration Center for Tobacco Products under Grant P50DA036128 and National Cancer Institute of the National Institutes of Health and the Food and Drug Administration Center for Tobacco Products under Grant R00CA187460. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Food and Drug Administration.

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Table 1.

Key Measures

Measures	Response options	Reliability (for scale)
Emotions		
While looking at the message, I felt:	1 (not at all) – 9 (extremely)	
Negative emotions: angry, afraid, guilty, disgusted		
Positive emotions: happy, hopeful		
Risk perceptions		
Imagine that you just began vaping e-cigarettes (or smoking cigarettes) every day. What do you think your chances are of having each of the following happen to you if you continue to vape e-cigarettes (or smoke cigarettes) every day?	0 (no chance) – 6 (very good chance) + I don't know ^a	E-cigarettes $\alpha = .94$; Cigarettes $\alpha = .91$;
Perceived absolute risks:		
- Lung cancer		
- Lung disease other than lung cancer (such as COPD and emphysema)		
- Heart disease		
- Become addicted		
- Early/Premature death		
Perceived comparative risk:	Three options + I don't know ^b	
Is using electronic cigarettes (vapes) less harmful, about the same, or more harmful than smoking regular cigarettes?		
Behavioral intentions		
Intentions to switch completely to e-cigarettes: How likely are you to switch completely from using regular cigarettes to electronic cigarettes in the next 6 months?	1 (not at all) – 9 (extremely)	
Dual use intentions: Which of the following are you most likely to do in the next month? (Pick one) ^c	Pick one option	
1. Only smoke cigarettes		
2. Mostly smoke cigarettes and occasionally use e-cigarettes		
3. Smoke cigarettes and use e-cigarettes about the same amount		
4. Occasionally smoke cigarettes and mostly use e-cigarettes		
5. Only use e-cigarettes		
6. Not smoke cigarettes and not use e-cigarettes		
7. Other: (please write your answer)_____		
Intentions to quit: ^d	0 (very definitely no) – 10 (very definitely yes)	
How much do you intend to quit in the next 6 months?		
Other intentions: ^d	1 (definitely will not) – 4 (definitely will)	Analyzed separately
- How likely is it that in the next 6 months you will seek counseling/ support to help you quit smoking?		
- How likely is it that in the next 6 months you will use nicotine gum, nicotine patch, or other form of nicotine replacement therapy (NRT)?		

Notes.

^aThe response category “I don’t know” was treated as missing value in the data analysis.

^bThe response categories “more harmful” and “about the same” were grouped together and compared with the reference category “less harmful.”

^cThe response category 7 was treated as missing value. The response categories 2, 3, and 4 were grouped together (dual use) and compared with the response categories 5 (exclusive e-cigarette use) and 6 (smoking cessation).

^dMeasured only among current smokers.

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Table 2.Descriptive Statistics of Key Measures ($N = 1,202$)

	Mean	Standard Deviation
Anger	2.88	2.48
Fear	3.86	2.87
Guilt	4.29	2.89
Disgust	3.51	2.81
Happiness	3.33	2.65
Hope	4.94	2.78
Perceived absolute cigarette risk	5.14	1.99
Perceived absolute e-cigarette risk	3.72	0.94
Intentions to switch to e-cigarettes completely	4.48	2.82
Intentions to quit smoking	6.36	3.19
Intentions to seek quit help	2.20	1.01
Intentions to use nicotine replacement therapy	2.50	1.04
Overall %		
Perceived comparative risk of e-cigarettes and cigarettes		
Less harmful	48.3	
Equally harmful	33.4	
More harmful	5.4	
I don't know	12.8	
Dual use intentions		
Exclusive smoking	35.6	
Dual use of cigarettes and e-cigarettes	40.5	
Exclusive e-cigarette use	10.1	
Cessation	13.9	

Table 3.Sample Characteristics (*N* = 1,202)

	Total %
Sex	
Male	46.3
Female	53.7
Age	
18–29	17.6
30–44	25.3
45–59	30.9
60+	26.2
Race	
White	82.4
Black or African American	8.1
Hispanic	3.7
American Indian or Alaska Native	1.2
Asian	3.6
Other	1.0
Education	
Less than high school	1.8
High school	34.6
Some college	32.7
Bachelor's degree or higher	30.9
Daily smoker	
Yes	61.6
No	38.4
E-Cigarette use	
Current	33.3
Ever but not current	22.5
Never	44.2
Current cigarette use	
Yes, but expect to quit	82.7
Yes, and never expect to quit	7.9
No, former smoker	9.4
Current dual user of e-cigarettes and cigarettes	
Yes	31.1
No	68.9
Tried to quit in the past 12 months	
Yes	49.0
No	51.0

Table 4.

Means, Standard Errors, and Univariate Statistics of Message Type on Emotions

	Comparative risk messages (CR messages) M (SE)	Negative comparative risk messages (CR- messages) M (SE)	Univariate <i>F</i> statistics
Anger	2.33 (0.10)	3.44 (0.10)	$F(1, 1192) = 66.77, p < .001, \eta_p^2 = .05$
Fear	2.81 (0.11)	4.91 (0.11)	$F(1, 1192) = 200.37, p < .001, \eta_p^2 = .14$
Guilt	3.57 (0.11)	5.00 (0.11)	$F(1, 1192) = 85.15, p < .001, \eta_p^2 = .07$
Disgust	2.73 (0.11)	4.29 (0.11)	$F(1, 1192) = 104.05, p < .001, \eta_p^2 = .08$
Happiness	3.98 (0.10)	2.68 (0.10)	$F(1, 1192) = 85.73, p < .001, \eta_p^2 = .07$
Hope	5.39 (0.11)	4.48 (0.11)	$F(1, 1192) = 36.30, p < .001, \eta_p^2 = .03$

Notes. Results of analyses of covariance controlling for e-cigarettes use, daily smoking, quit attempt in the past 12 months, sex, age, race, and education. M: marginal means; SE: standard errors.

Table 5.

Predictors of Cigarettes Risk Perceptions, Quit, and Quit-Related Intentions

Predictors	Perceived absolute cigarette risk		Intentions to quit smoking		Intentions to seek quit help		Intentions to use nicotine replacement therapy	
	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>
Step 1								
Message type (CR- vs. CR)	0.03	-0.07	-0.15	-0.30	0.05	-0.05	0.00	-0.08
Ever but not current e-cigarette use (vs. never use)	0.02	0.02	0.04	0.05	-0.10	-0.07	0.09	0.11
Current e-cigarette use (vs. never use)	0.12	0.02	0.61	0.25	0.24	0.10	0.37	0.24
Past 12-month quit attempt (no vs. yes)	-0.41	-0.32	-2.30	-1.94	-0.37	-0.22	-0.44	-0.29
Daily smokers (yes vs. no)	0.05	0.04	-0.48	-0.34	-0.05	0.02	0.10	0.16
Age in years	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00
Female (vs. male)	0.12	0.14	-0.17	-0.07	-0.23	-0.14	-0.16	-0.11
White (vs. non-White)	-0.02	0.02	-0.10	0.07	-0.15	-0.08	-0.14	-0.07
Below college education (vs. college or above)	0.18	0.17	0.15	0.05	0.01	-0.02	-0.03	-0.05
Step 2								
Anger		-0.05		-0.11		0.01		-0.01
Fear		0.03		0.12		0.06		0.04
Guilt		0.05		0.08		0.02		0.05
Disgust		0.02		0.09		0.04		0.02
Happiness		-0.03		-0.02		0.05		0.03
Hope		0.07		0.28		0.06		0.07
<i>R</i> ²	0.04	0.12	0.21	0.30	0.12	0.27	0.10	0.23
<i>R</i> ² Change	0.04	0.08	0.21	0.10	0.12	0.15	0.10	0.13

Notes. Results of hierarchical OLS regression analyses. Reported *b* for each variable is unstandardized regression coefficient. VIF for each variable was smaller than 3, below rule of thumb indicating multicollinearity. Current e-cigarette use refers to self-reported use of e-cigarettes in the past 30 days.

Boldface indicates statistical significance at $p < .05$.

Table 6.
Predictors of E-Cigarettes Risk Perceptions, Switch Intentions, and Dual Use Intentions

Predictors	Perceived comparative risk						Dual use intentions					
	Perceived absolute e-cigarette risk ^a		Intentions to switch to e-cigarettes completely ^a		E-cigarettes being more or equally harmful (vs. e-cigarettes being less harmful) ^b		I don't know (vs. e-cigarettes being less harmful) ^b		Exclusive e-cigarette use (vs. dual use intentions) ^b		Cessation (vs. dual use intentions) ^b	
	b	b	b	b	aOR	aOR	aOR	aOR	aOR	aOR	aOR	aOR
Step 1												
Message type (CR- vs. CR)	0.27	-0.01	-0.22	0.00	1.15	0.94	1.43	1.10	0.93	1.32	1.08	0.92
Ever but not current e-cigarette use (vs. never use)	-0.44	-0.45	0.51	0.59	0.46	0.44	0.53	0.50	1.39	1.45	0.53	0.49
Current e-cigarette use (vs. never use)	-0.65	-0.63	2.80	2.27	0.35	0.38	0.22	0.26	2.01	2.03	0.11	0.11
Past 12-month quit attempt (no vs. yes)	-0.18	-0.13	-0.67	-0.37	1.22	1.20	1.02	0.90	0.65	0.66	0.27	0.25
Daily smokers (yes vs. no)	-0.35	-0.33	-0.08	0.08	0.87	0.90	1.05	0.93	0.40	0.40	0.21	0.20
Age in years	0.00	0.00	-0.02	-0.01	0.99	0.99	1.01	1.01	1.02	1.01	1.02	1.02
Female (vs. male)	0.17	0.26	-0.33	-0.14	1.23	1.38	1.49	1.46	1.25	1.25	1.80	1.76
White (vs. non-White)	0.40	0.36	-0.64	-0.35	1.22	1.13	1.27	1.12	0.90	0.88	1.26	1.17
Below college education (vs. college or above)	-0.17	-0.16	0.08	0.03	1.05	1.06	1.08	1.08	1.42	1.41	1.41	1.43
Step 2												
Anger		0.03		-0.05		1.20		1.10		0.92		1.07
Fear		0.05		0.10		0.98		1.03		0.92		0.99
Guilt		-0.02		0.06		0.89		0.96		0.94		0.92
Disgust		0.09		0.00		1.10		0.95		1.15		1.06
Happiness		0.04		0.15		1.09		0.91		0.97		0.93
Hope		-0.07		0.28		0.83		0.85		1.23		0.92
R ²	0.06	0.11	0.29	0.44	0.10 ^c	0.21 ^c	0.10 ^c	0.21 ^c	0.46 ^c	0.52 ^c	0.46 ^c	0.52 ^c
R ² Change	0.06	0.05	0.29	0.14	--	--	--	--	--	--	--	--

Notes.

^aResults of hierarchical OLS regression analyses. Reported *b* for each variable is unstandardized regression coefficient. VIF for each variable was smaller than 3, below rule of thumb indicating multicollinearity.

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η^2 Results of hierarchical multinomial logistic regression analyses. aOR = adjusted odds ratio.

R^2 ; Nagelkerke R^2 does not refer to the amount of variance explained by the predictors in the model as OLS R^2 . Similarly, change in Nagelkerke R^2 does not represent the amount of variance in the outcome variable explained by the added predictors. No Nagelkerke R^2 change is reported.

Current e-cigarette use refers to self-reported use of e-cigarettes in the past 30 days. Boldface indicates statistical significance at $p < .05$.