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Testing Competing Explanations for Graphic Warning Label Effects Among Adult Smokers and Non-Smoking Youth

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Abstract

Rationale—The U.S. courts have blocked the implementation of graphic warning labels on cigarette packages (GWLs). This decision was based, in part, on the premise that GWLs are unnecessarily emotional and are meant to scare rather than inform consumers about smoking's health effects. However, research in judgment and decision-making suggests these relationships are more complex.

Objective—In this paper, we drew on several theoretical frameworks that lead to competing hypotheses about the relationships between negative affect, health risk beliefs, and quit intentions (among adult smokers) or susceptibility to start smoking (among non-smoking youth).

Method—We tested these competing mediation models using data from two experiments with two populations each—adult smokers ($N=313$, 238) and primarily non-smoking middle-school youth ($N=340$, 237). Using mobile recruitment methods, we focused specifically on individuals from socioeconomically disadvantaged communities in rural and urban areas of the Northeastern U.S.

Results—The best fitting model across all four datasets was one in which label-induced negative affect (a) directly predicted intentions/susceptibility but also (b) indirectly predicted intentions/susceptibility via risk beliefs. Although mediation analyses did not demonstrate significant serial mediation effects of GWL exposure on intentions/susceptibility through negative affect then risk beliefs, there was some evidence that GWL exposure indirectly promoted adults' quit intentions

through negative affect. Additionally, negative affect consistently mediated the indirect effect of GWL exposure on strengthened risk beliefs among adults and youth.

Conclusions—These results speak to the importance of negative affect in directly motivating adult smokers' quit intentions but also serving an informational function, directing adult smokers and non-smoking youth to accept the health risks of smoking.

Keywords

U.S.; graphic warning labels; emotion; risk beliefs; adult smokers; youth; health communication; tobacco control

Introduction

Tobacco use is estimated to be responsible for the deaths of one in 10 people globally (Reitsma et al., 2017). One evidence-based strategy to address the tobacco epidemic, endorsed by the World Health Organization's Global Framework on Tobacco Control and implemented by over 100 countries/jurisdictions, is to require graphic warning labels (GWLs) on cigarette packages (Canadian Cancer Society, 2016). GWLs use hard-hitting imagery and text to convey the risks of tobacco use to consumers and potential consumers (Hammond, 2011). Strengthening GWLs (e.g., including images, increasing GWL size) is associated with greater recall, more quit attempts, and increased rates of successful quitting (Brewer et al., 2016; Noar et al., 2015).

The U.S. has not implemented GWLs, in part, because of a 2012 federal appeals court decision blocking mandatory GWLs on free speech grounds. The court concluded that GWLs are unnecessarily emotional and intend to scare rather than inform consumers about smoking's health effects ("RJ Reynolds Tobacco Co. v. Food and Drug Admin," 2012). This argument implicitly assumes that graphic, pictorial warnings are emotional whereas text-based warnings are informational (Jolls, 2015; Popova, Owusu, Jenson, & Neilands, 2017). Research in human judgment and decision-making, however, suggests these relationships are more complex. Considering legal uncertainty and gaps in extant theory and research on the roles of emotion and cognition in shaping behavior, we tested competing explanations for the indirect effects of GWL exposure on behavioral intentions (among adult smokers) and susceptibility to starting smoking (among youth) via affective and non-affective pathways. We take a strong inference approach (Platt, 1964), which requires the researcher to test several competing explanations for the phenomenon under investigation. To do so, we assessed the fit of multiple theoretical models using data from two between-subjects, randomized experiments—each with adult smokers and (largely non-smoking) middle-school youth.

The U.S. Legal Question: Emotion and the Law

The 2009 Family Smoking Prevention and Tobacco Control Act required the U.S. Food and Drug Administration (FDA) to regulate the marketing of tobacco products. The FDA later proposed nine full-color GWLs to inform consumers about the harmful effects of smoking. Five tobacco companies sued the FDA, alleging that the proposed GWLs violated their First Amendment right to free speech ("RJ Reynolds Tobacco v. US Food and Drug Admin,"

2011). Attorneys representing the tobacco industry claimed that the warnings intended to scare consumers through unduly emotional tactics rather than inform consumers about the risks associated with cigarette smoking.

Although the Court of Appeals for the Sixth Circuit court initially sided with the FDA, the Court of Appeals for the DC Circuit (in a 2–1 decision) sided with the tobacco companies. Writing for the majority, Judge Brown argued that the proposed GWL images are not factual, not uncontroversial, and therefore are subject to misinterpretation by consumers. Furthermore, Brown reasoned that the GWLs could not be factual as they were “primarily intended to evoke an emotional response, or, at most, shock the viewer into retaining the information in the text warning” (“RJ Reynolds Tobacco Co. v. Food and Drug Admin,” 2012). Although a disagreement between Circuits can be a basis for Supreme Court review, the FDA did not seek review of the DC Circuit decision and as of June 2018 has yet to issue revised GWLs.

A key concern in the DC court’s ruling (and for the legality of GWLs moving forward) is whether GWLs sidestep consumers’ ability to make “rational” decisions by evoking emotions (Cortez, 2013). Emotion researchers (Peters, Evans, Hemmerich, & Berman, 2016) and legal experts (Goodman, 2013; Tushnet, 2014) have criticized the court’s decision for its reliance on lay theories in which emotions are thought to be irrational impulses that impede the consumer from making sensible judgments. This thinking contradicts decades of psychological research that suggests effective decision-making requires the integration of affect and analytic thinking (Peters et al., 2016). Nevertheless, the tobacco industry is likely to bring suit again once the FDA proposes a new set of GWLs. It is therefore critical that researchers in this domain have a firm understanding of the psychological processes that best explain how smokers (and potential smokers) respond to strengthened GWLs (Cappella, 2016). In the sections that follow, we elaborate on different psychological perspectives on how people process risk information, which lead us to several competing hypotheses about the mechanisms of GWL effects.

Processing GWLs Analytically

Dual-process theories of information processing identify two routes by which people process messages and make decisions—one analytic and one experiential. The first route involves careful deliberation in which the individual expends considerable cognitive energy and draws on formal logic to make judgments. Psychologists have used the terms central processing (Petty & Cacioppo, 1986), systematic processing (Chaiken, 1980), the rational system (Epstein, 1994), and the analytic system (Slovic, Finucane, Peters, & MacGregor, 2004) to describe this kind of thinking. In this paper, we use the phrase *risk as analysis*, a phrase consistent with research in the risk perception literature (Slovic et al., 2004). Using the risk-as-analysis framework, one would predict that exposure to GWLs has downstream effects on behavior by instilling beliefs about the presented health risks associated with smoking. To the extent that tobacco consumers (or potential users) adopt those risk beliefs, quit intentions (or susceptibility to try smoking) should be indirectly influenced. This argument aligns with predictions made by the health belief model (Rosenstock, 1974) in that

increased threat perceptions (consisting of perceived severity and susceptibility) should motivate protective action.

There is some evidence, albeit limited, to support this pathway of GWL effects. One study found that adult smokers who notice GWLs were more likely to hold beliefs about smoking's health risks (e.g., heart disease, stroke, lung cancer in non-smokers) (Hammond, Fong, McNeill, Borland, & Cummings, 2006). Among adolescents, the implementation of more prominent GWLs in Australia (including color images, increasing size) was associated with greater beliefs related to some new claims made by the GWLs (e.g., that smoking causes diseases of the fingers, toes, and mouth) (White, Webster, & Wakefield, 2008). Furthermore, smokers who endorse more beliefs about the health effects of smoking are more likely to plan to quit (Hammond et al., 2006). We thus offer our first competing hypothesis about the indirect effect of label exposure (i.e., including an image or text on a branded cigarette pack) on quit intentions (adults) and smoking susceptibility (youth) through novel risk beliefs.

Competing H1: Smoking risk beliefs will mediate the effect of label exposure on behavioral intentions.

For simplicity, throughout this section we use “behavioral intentions” as shorthand for both quit intentions among adults and smoking susceptibility (which contains items linked to theories of both behavioral intentions and behavioral willingness) among middle-school youth.

Processing GWLs Emotionally

Psychologists have described a second route of information processing that involves less effortful, cognitive deliberation of information and is instead characterized by employing mental shortcuts (when available) to base judgments. This route has been referred to as peripheral route processing (Petty & Cacioppo, 1986) or heuristic processing (Chaiken, 1980). For some theorists, this second processing pathway can involve relying on feelings when making decisions (Epstein, 1994; Slovic et al., 2004). This is the *risk-as-feelings* framework within the risk perception literature (Loewenstein, Weber, Hsee, & Welch, 2001). It posits that feelings can have two kinds of effects. First, feelings can motivate behavior independently of cognitive evaluations of risk, and second, they can also inform those cognitive evaluations. These feelings on which we draw may be simple *affect*, i.e., general positive or negative feelings (Slovic et al., 2004), or more complex *emotional* states like fear or anxiety.

Affect as behavior motivator.

In the context of health communication, Peters, Lipkus, and Diefenbach (2006) argue that affect can serve multiple functions. One such function is motivating behavior. Emotion theorists have long recognized that discrete emotions are associated with specific action tendencies (Frijda, 1986). Fear, for example, is accompanied by a flight response to avert a threatening situation, whereas anger predisposes a person to retaliate against the perceived source of some wrongdoing. In this way, emotions can motivate behaviors directly, bypassing effortful deliberation associated with analytic processing of risk information.

Pursuant to this claim, emotion theorists generally agree that emotions are functional (Izard, 2010) insofar as they allow humans to flexibly adapt to unique situations by coordinating response systems, directing attention, and organizing behavior (Keltner & Gross, 1999).

A handful of studies have employed path-analytic techniques to assess the indirect effect of GWLs on behavioral outcomes through affect. Emery and colleagues (2014) found that including a picture indirectly decreased desire to smoke through self-reported worry. In other experiments comparing text-only and pictorial GWLs, negative affect has mediated GWL effects on adult smokers' quit intentions (Evans et al., 2015; Hall et al., 2017). Similar findings have emerged with fear mediating the relationship between GWL graphicness and quit-related outcomes for adolescent smokers (Andrews, Netemeyer, Kees, & Burton, 2014) and adult smokers (Kees, Burton, Andrews, & Kozup, 2010). In another study of young people aged 14–22, feelings about smoking significantly predicted having tried a cigarette, but beliefs about the immediate harms posed by smoking did not (Romer & Jamieson, 2001). Consistent with the notion that affect motivates behavior, these studies lead us to offer our second competing hypothesis.

Competing H2: Negative affect will mediate the effect of label exposure on behavioral intentions.

Affect as a function of beliefs.

We have thus far advanced hypotheses that treat GWL effects as purely cognitive or purely affective. Yet many scholars argue that cognition and affect are not independent psychological processes—especially in the context of risk judgments (Loewenstein et al., 2001). According to appraisal theories of emotion (Roseman, 1984; Scherer, 1984; Smith & Ellsworth, 1985), emotions are intimately tied to cognitive appraisals of a situation, which are conscious or unconscious assessments of the significance of the environment relative to one's goals and well-being (Lazarus, 1991). Though not all appraisal theorists consider cognitive appraisals to be causal precursors to emotion (e.g., Ellsworth & Scherer, 2003), other theorists do (e.g., Ortony, Clore, & Collins, 1988; Roseman & Evdokas, 2004). As an example of the latter tradition, fear appeal theorizing (Witte, 1994) posits that one can evoke fear by inducing appraisals of threat (both severity and susceptibility). These appraisals are thought to elicit fear, which consequently is thought to influence attitudes and behaviors.

This line of work suggests that beliefs about the harms associated with cigarette smoking generate negative affect, which then influence behavioral intentions. Such a pathway of effects emerged in Yong et al.'s (2014) analysis of longitudinal data from the International Tobacco Control Four-Country survey. GWL salience (i.e., reporting paying attention to the labels) was positively associated with thoughts about smoking risks, which positively predicted feeling worried about future outcomes, which in turn correlated positively with quit intentions and quit attempts. The indirect effect of salience on quit attempts through these three mediators was positive and significant, suggesting that the salience of GWLs can have downstream impacts on cessation behavior by first provoking thoughts about smoking-related risks and then generating feelings of concern. Our next competing hypothesis follows this sequence:

Competing H3: Risk beliefs then negative affect will sequentially mediate the effect of label exposure on behavioral intentions.

Beliefs as a function of affect.

By and large, emotion research examining the interplay between belief and affect has conceptualized beliefs as cognitive precursors to emotional arousal (Frijda, Manstead, & Bem, 2000). Yet some scholars have argued that emotional experiences come earlier in the process of how we respond to environmental stimuli (Zajonc, 1980). In this way, affect can serve an informational function (Peters et al., 2006). Akin to the concept of the affect heuristic (Slovic et al., 2004), mental representations of the outside world are thought to be tagged with positive or negative feelings, and the cognitions generated by these feelings (not the feelings themselves) serve as the basis for behavioral decisions. Several studies have demonstrated that when a stimulus evokes positive affect, people perceive the action's risks to be low and the benefits as high, whereas stimuli associated with negative affect increase perceptions of risk and decrease perceived benefits (Slovic, 2001). As such, affect can serve an informational purpose (Schwarz & Clore, 1983), shaping our thoughts and beliefs about risk that in turn guide behavior.

In the context of GWLs, this pattern appears in the message impact framework (Noar, Francis, Bridges, Sontag, Ribisl, et al., 2016), which proposes a series of steps by which GWLs indirectly influence smoking-related behavior: GWLs→attention and recall→warning reactions (e.g., negative affect)→attitudes and beliefs→intentions→behavior. Consistent with the affect-as-information function, the message impact framework suggests that affective responses to GWLs precede risk beliefs about smoking's health effects, which in turn impact behavioral outcomes. Andrews and colleagues (2014) found that warning graphicness increased fear, which positively predicted negative beliefs about the health consequences of smoking, which produced stronger thoughts about quitting. Similar results have emerged in a longitudinal study of smokers in the US and Canada (but not Mexico or Australia) (Cho et al., 2017) and in another longitudinal study of US smokers (Hall et al., 2017). We thus offer a fourth, competing hypothesis:

Competing H4: Negative affect then risk beliefs will sequentially mediate the effect of label exposure on behavioral intentions.

Affect as motivator and information.

We test a final model in which negative affect simultaneously motivates behavior and serves as an informational function. In this model, exposure to GWLs induces negative affect, and negative affect directly predicts smoking-related behavior as well as risk beliefs about smoking's harms. Risk beliefs in turn associate with behavior. This model subsumes the models proffered in competing hypotheses two and four. It predicts that negative affect relates to smoking behavior directly by motivating behavior but also indirectly by functioning as a heuristic that informs risk beliefs, which in turn influence behavior. Evidence consistent with this dual-pathway model has emerged in research described above (Andrews et al., 2014; Cho et al., 2017; Emery et al., 2014; Evans et al., 2015; Hall et al., 2017), so we predict:

Competing H5: Label exposure will indirectly influence behavioral intention through two simultaneous paths: (a) negative affect and (b) negative affect then risk beliefs.

We compared these competing predictions about the mechanism(s) of label effects using data from four datasets: two with adult smokers and two with (primarily non-smoking) youth. Using data from two experiments across two populations allowed us to evaluate the reliability of our competing models. Specifically, we recruited from socioeconomically disadvantaged communities because these populations are at highest risk for tobacco-related conditions (Henley et al., 2016) but are often under-represented in this line of research (Noar, Francis, Bridges, Sontag, Brewer, et al., 2016).

Method

Recruitment

We recruited adult smokers ($N_{\text{experiment 1}}=313$, $N_{\text{experiment 2}}=238$, see Table 1 for demographics) throughout rural and urban communities in the Northeastern US by first using US Census data to identify zip codes where median household income was at or below \$35,000. We also contacted organizations and community centers in these zip codes and in other locations of interest that serve low-income communities. When possible, these organizations disseminated advertisements in advance of data collection. We advertised the study as a “Health Messaging Study” for regular adult smokers and utilized street-intercept techniques to recruit participants. To qualify for the studies, interested individuals had to biochemically confirm that they were regular smokers by getting a score of seven or higher on a CoVita breath test, which measures exhaled carbon monoxide. If requested, we occasionally administered an Alere saliva test, which screens for cotinine (a nicotine byproduct).

We recruited youth participants ($N_{\text{experiment 1}}=340$, $N_{\text{experiment 2}}=237$) by identifying middle schools where at least 40% of students received free or reduced-price lunch. We worked with school boards and district/school administrators to receive approval to work with students in grades six-eight. Students took home an informational sheet about the research that allowed parents to opt out their children. We did not require youth participants to be smokers, so we did not biochemically assess their smoking status.

Procedure

We informed individuals of their rights as research participants before beginning the study. Adults provided informed consent, and youth provided assent. The remainder of study procedures happened in a mobile research laboratory fitted with five computer stations to display the experimental stimuli. Research associates first led participants through a brief eyetracking calibration procedure in order to collect data on visual attention to the stimuli as part of a separate series of studies. We do not include eyetracking data in this paper, as these measures do not pertain to the current hypotheses (see Byrne et al., 2017; Skurka et al., 2017). Participants next viewed the experimental stimuli (nine cigarette pack images, described below) then self-reported negative affect, beliefs about the health risks of smoking, quit intentions (or susceptibility to smoking for youth), other covariates, and

demographics. After debriefing participants about the study's purpose, we compensated adult smokers with \$20. Youth participants received a \$10 gift card, or we made a \$10 school donation per student (depending on school preference). These procedures were the same for all studies, and data were collected in the spring of 2016. The researchers' university IRB approved all study protocols.

Stimuli

All participants viewed a slideshow of nine images of the front of cigarette packages, appearing in random order. Each image appeared for 10 seconds. Sample stimuli for both experiments appear in Figures 1 and 2. We used three popular cigarette brands in our stimuli (Marlboro, Camel, Newport), and each brand appeared to each participant three times. We rotated the pairings between cigarette brand and warning label so that labels would not become associated with particular brands. In the first experiment (hereafter, "graphic"), we randomly assigned adults and youth to one of five between-subjects conditions: (1) 50% full-color GWLs (including text and images) proposed by the FDA in 2011, (2) 50% black and white versions of the FDA-proposed GWLs, (3) 50% text-only versions of the FDA-proposed GWLs, (4) 50% labels displaying text from the current Surgeon General's warnings, or (5) brand-only cigarette packs without any warning labels (control). In the second experiment (hereafter, "size"), we manipulated size of the GWL for three between-subjects conditions: (1) 50% GWLs full-color GWLs (text and images) originally proposed by the FDA, (2) 30% full-color versions of the FDA-proposed GWLs, or (3) brand-only packs without warnings (control). We modified the original, FDA-proposed GWLs slightly by removing the telephone quit line and using the same font for all nine images. We report the main effect results of these manipulations elsewhere (Byrne et al., 2017; Skurka et al., 2017).

Measures

Risk beliefs.—We asked adults to indicate their agreement with four statements about the health risks of smoking (Hyland et al., 2016): "Based on what you know or believe, does smoking cigarettes cause...": "children to have breathing problems from secondhand smoke?", "lung disease in nonsmokers from secondhand smoke?", "stroke in smokers?", and "mouth cancer in smokers?". We selected these beliefs because they are not claims made in the current Surgeon General's warnings but directly correspond to claims featured in the FDA-proposed warnings. Adults answered *yes*, *no*, or *not sure*. We summed these items (1=*yes*; 0=*no*, *not sure*) into a risk beliefs index (see supplementary materials for variable means).

Youth responded to a different set of items. "Do you believe cigarette smoking is related to...": "health problems in non-smokers?", "stroke?", and "hole in the throat?". Youth also indicated their agreement with "Can smoking cigarettes kill you?" and "Are cigarettes very addictive?". Response choices for all items ranged from 1=*definitely not* to 4=*definitely yes*. We recoded responses as 1=*definitely yes* and 0=all other responses and created a summative risk beliefs index.

Negative affect.—We asked both adults and youth to indicate the extent to which they felt *afraid, angry, annoyed, disturbed, grossed out, guilty, sad, and scared* in response to viewing the cigarette packages. These items were taken from the expanded PANAS instrument (Watson & Clark, 1999). Participants rated their feelings on a scale of 1=*not at all* to 5=*extremely*. Because these eight items were highly correlated (Cronbach's α range=.84-.93), we averaged responses into negative affect indices.

Quit intentions (adults).—We asked adult smokers about their willingness to quit smoking using items borrowed from the National Adult Tobacco Survey (Centers for Disease Control and Prevention, 2016): “Do you want to quit smoking cigarettes for good?”, “Do you have a time frame in mind for quitting?”. If participants answered yes to both questions, they indicated whether they planned to quit smoking for good in the next seven days, next 30 days, next six months, next year, or more than one year from now. We created a dichotomous quit intention variable with 1=quit intention in seven days, 30 days, or six months and 0=quit intention in the next year, more than one year, or no quit intention.

Smoking susceptibility (youth).—We adapted items from previously validated instruments on smoking susceptibility to smoking initiation (Jackson, 1998; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996). Youth participants read the prompt, “Do you think that...” and responded to five items: “you will smoke a cigarette soon?”, “you will smoke a cigarette in the next year?”, “you will be smoking cigarettes in high school?”, “in the future you might try a cigarette?”, and “if one of your best friends offered you a cigarette would you smoke it?”. Participants used a scale of 1=*definitely not* to 4=*definitely yes*. Following standard coding procedures, we re-coded responses such that a participant received a 0 if they selected *definitely not* for all items or a 1 if they selected anything other than *definitely not*.

Analytic Strategy—We began the analysis by comparing the fit of each of the first four of our hypothesized path models using the *lavaan* package for R (Rosseel, 2012). Because the intention variables were dichotomous and the risk beliefs variables were summative indices, we used diagonally weighted least squares for parameter estimation with scale-shifted test statistics. This estimation technique has less stringent sample size requirements than other estimators, and it does not assume normal distribution, making it superior to other forms of estimation (e.g., maximum likelihood, weighted least squares) when analyzing non-continuous variables (Beauducel & Herzberg, 2006; Brown, 2014). Missing data were minimal across the datasets (range of missingness per variable: 0%–3.9%), so we handled missing data with listwise deletion (Allison, 2001).

We dummy coded the conditions to create exogenous variables. For the graphic experiment, we created one dummy variable for pictorial GWLs (1=full color, black/white; 0=text-only FDA, Surgeon General, control) and another dummy variable for text-only warnings (1=text-only FDA, Surgeon General; 0=full color, black/white, control). Thus, when including both of these dummy variables in a model, these dummies can be interpreted as pictorial vs. control and text-only vs. control. We collapsed conditions in this way based on similar patterns of effects on negative affect and health risk beliefs in the main effect paper analyses (see Byrne et al., 2017; Skurka et al., 2017). Similarly, we recoded our size experiment

conditions into two dummy variables: 50% GWL (1=50%; 0=30%, control) and 30% GWL (1=30%; 0=50%, control). These dummies can be interpreted as type of label vs. no-label control when simultaneously included in the model.

We report several fit indices for each path model as recommended when assessing model fit (Bentler, 2007): model chi-square (χ^2), comparative fit index (CFI), the root mean-squared error of approximation (RMSEA), and the standardized root mean squared residual (SRMR). Acceptable fit values for each index are: a non-significant chi-square test statistic ($p>.05$), CFI .95, RMSEA .06, and SRMR .08 (Hu & Bentler, 1999).

We subjected models that consistently fit the data to formal mediation tests using the *lavaan* package for R. As before, we used diagonally weighted least squares estimation with robust standard errors to account for an ordinal mediator (risk beliefs) and binary outcome (intentions).

Results

Competing hypotheses

H1 and H2. The first two hypotheses predicted that risk beliefs (competing H1) and negative affect (competing H2) would independently mediate the effect of warning label exposure on quit intentions (adults) and smoking susceptibility (youth). We included these two variables as parallel mediators in the same model to control for the influence of the other mediator on the dependent variables. The model displayed less than adequate fit for all four datasets (see Tables 2 and 3 for fit indices). Together, these results do not support competing H1 or H2.

H3. With competing H3, we predicted that viewing GWLs would impact risk beliefs first, which in turn should influence negative affect and, ultimately, intentions/susceptibility. Though the SRMR values were acceptable for two of the four datasets, all other fit values indicated poor fit of this theoretical model to the observed data (Tables 2 and 3). These findings do not support competing H3.

H4. According to competing H4, negative affect should precede risk beliefs in mediating label effects on intentions. For the adults, this serial mediation model fit the graphic experiment data well but not the size experiment data (Table 2). By contrast, all fit indices were high for both youth datasets (Table 3). Thus, these data support competing H4 among youth but do not consistently support H4 among adults.

H5. The final hypothesis predicted that (a) negative affect by itself would mediate the relationship between label exposure and intentions while (b) negative affect then risk beliefs would serially mediate this relationship. Fit indices were excellent for all four datasets (Tables 2 and 3). These data offer strong, consistent support for competing H5 among youth and adults.

Mediation

Because the fourth model (competing H5) demonstrated the best fit for all four datasets, we conducted mediation analyses in *lavaan* to explore the significance of the indirect effect of GWLs on quit intentions/susceptibility via (a) negative affect and (b) negative affect then risk beliefs. We were also able to simultaneously assess the third model (competing H4) with the two youth datasets because the fourth model (competing H5) subsumes the third model (competing H4). Overall, these data largely confirm the findings of the path models, although some paths became non-significant when controlling for other pathways of influence.

Adults.

In the graphic experiment, exposure to a warning label (text-only or pictorial) increased negative affect, which was positively (but marginally) associated with quit intentions (Figure 3). Formal mediation tests indicated that the indirect effect of text-only warnings (vs. control) on quit intentions through negative affect was not significant (indirect effect [IE]=.06, standard error [SE]=.04, p =.14). The indirect effect of pictorial warnings was marginally significant (IE =.16, SE =.09, p =.07). Regarding the serial mediation path of negative affect then risk beliefs, label exposure increased negative affect, which predicted stronger risk beliefs, which in turn were associated with increased quit intentions. However, the indirect effect of text-only warnings (vs. control) was not significant (IE =.02, SE =.01, p =.15), and the indirect effect of pictorial warnings was marginally significant (IE =.04, SE =.03, p =.08).

In the size experiment, increased negative affect mediated the effect of 30% GWLs (vs. control) on increased quit intentions (IE =.42, SE =.12, p <.001) and the effect of 50% GWLs (vs. control) on increased quit intentions (IE =.39, SE =.11, p =.001). However, the serial mediation paths (negative affect before risk beliefs) were not significant for the 30% GWL (IE =.06, SE =.04, p =.11) or 50% GWL (IE =.06, SE =.03, p =.11). These non-significant, serial mediation effects can be explained by the marginal relationship between risk beliefs and quit intentions.

Youth.

For the graphic experiment, negative affect did not mediate the effect of text-based warnings (vs. control) on susceptibility to smoking (IE =-.03, SE =.05, p =.48) or the effect of pictorial warnings (vs. control) on susceptibility (IE =-.03, SE =.05, p =.48). Regarding the serial mediation path, label exposure increased negative affect, which positively associated with risk beliefs, and stronger risk beliefs were marginally associated with decreased susceptibility to smoking. Formal mediation tests indicated that neither serial mediation path was significant ($IE_{\text{text}}=-.02$, $SE_{\text{text}}=.01$, p =.14; $IE_{\text{pictorial}}=-.02$, $SE_{\text{pictorial}}=.01$, p =.14).

In the size experiment, there was no evidence of simple mediation. In other words, because negative affect was unrelated to susceptibility, there was no indirect effect of 30% GWLs (IE =-.002, SE =.05, p =.96) or 50% GWLs (IE =-.003, SE =.06, p =.96) on smoking susceptibility by way of negative affect. Similarly, the serial mediation paths of GWL→negative affect→risk beliefs→susceptibility were not significant ($IE_{30\%}=-.01$, $SE_{30\%}=.02$, p =.39; $IE_{50\%}=-.02$, $SE_{50\%}=.02$, p =.40). As with the adult data, the serial

mediation path was not significant due to the non-significant path from risk beliefs to susceptibility.

Post hoc tests: GWL→negative affect→risk beliefs

Because the serial mediation paths of GWL→negative affect→risk beliefs→intentions/susceptibility were not significantly different from zero, we also explored whether negative affect solely mediated the indirect effect of label exposure on risk beliefs. Across the four datasets, label exposure increased negative affect, which in turn associated positively with risk beliefs. For the adults, the indirect effect of text-only labels was marginal ($IE=.08$, $SE=.04$, $p=.06$), but the indirect effect of pictorial labels was significant ($IE=.21$, $SE=.08$, $p<.01$). In the size experiment (adults), the indirect effects of label exposure were significant ($IE_{30\%}=.36$, $SE_{30\%}=.09$, $p<.001$; $IE_{50\%}=.33$, $SE_{50\%}=.09$, $p<.001$). For youth, the indirect effects of label exposure were significant in both the graphic experiment ($IE_{\text{text}}=.15$, $SE_{\text{text}}=.06$, $p<.01$; $IE_{\text{pictorial}}=.15$, $SE_{\text{pictorial}}=.05$, $p<.01$) and the size experiment ($IE_{30\%}=.16$, $SE_{30\%}=.06$, $p<.01$; $IE_{50\%}=.19$, $SE_{50\%}=.06$, $p<.01$).

Discussion

These study findings underscore the central role of negative affective responses to warning labels but also suggest an important (secondary and serial) role for health risk beliefs—particularly among youth. Negative affect served two concomitant functions among adults. First, our data provide some evidence that negative affective responses to GWLs can directly motivate adults' quit intentions (Peters et al., 2006). Second, our data support the contention that negative affect promotes acceptance of health risk beliefs, serving a heuristic or informational function (Loewenstein et al., 2001; Peters et al., 2006). This is not the first time scholars have documented a dual purpose for negative affect in the context of GWL effects (Evans et al., 2015; Hall et al., 2017). Although risk beliefs did not predict adults' quit intentions in our experiment manipulating GWL size, our first experiment replicates this finding with a low-income population of adult smokers.

Our data also offer evidence that negative affective responses to warnings serve an informational function among youth, shaping risk beliefs about smoking. However, affective reactions did not predict reduced susceptibility to smoking, directly or indirectly. Contrary to the pattern between negative affect and quit intentions observed among adults, negative affect did not (simply) mediate the relationship between label exposure and smoking susceptibility in either youth experiment. Nonetheless, our post hoc analyses indicate that youth use affect as informational input that may shape their future expectations about smoking risks.

Compared to adults, it is surprising that negative affect played a less prominent role in shaping adolescents' behavioral intentions. Previous evidence suggests that young people tend to draw more on their feelings about smoking (rather than risk beliefs) when considering initiating smoking, whereas the reverse is usually the case for established smokers (Andrews et al., 2014; Romer & Jamieson, 2001). Although feelings about smoking seem to play a greater role in cigarette initiation than risk perceptions (Slovic, 2001), perhaps we did not observe a relationship between affect and susceptibility because we

focused exclusively on negative affect. Previous work suggests positive affect (e.g., feeling that smoking is “cool”) may drive smoking initiation (Popova et al., 2018). Future investigations should measure positive affective reactions to warning labels to explore whether warnings indirectly dampen susceptibility by reducing positive affect.

Nonetheless, negative affect appears to be a necessary, intermediary step between GWL exposure and downstream outcomes for youth and adults. Although there is some evidence that elaboration about the risks of smoking influences feelings of worry (Yong et al., 2014), our results call into question the primacy of risk beliefs in how adult smokers and at-risk youth process GWLs. This is consistent with previous work showing no direct effects of GWLs on risk perceptions (Emery et al., 2014; Evans et al., 2015). One possible explanation for the limited role of risk beliefs in our studies is ceiling effects. Acceptance of risk beliefs was generally high across all studies (range of proportions with the highest possible risk belief scores=38.7%–62.9%). If there is limited room to increase risk belief acceptance beyond levels that have already been established, it seems likely that GWLs exert their influence through label features that provoke an emotional response, rather than via transmitting the risk information itself.

On a theoretical note, our findings provide evidence for the utility of the message impact framework (Noar, Francis, Bridges, Sontag, Brewer, et al., 2016). According to the framework, consumers first orient to the warning, followed by immediate emotional reactions. These reactions shape attitudes and beliefs, which in turn influence intentions and behavior. In this study, participants responded to key variables at the same time, so the causal sequence of negative affect→risk beliefs→intentions is not ironclad. However, we compared several competing hypotheses about causal ordering and our data were most consistent with the causal process described by the message impact framework. Our results do suggest that some smokers may not go through all of the model’s linear stages of processing GWLs, given that negative affect directly predicted quit intentions in our size experiment. We encourage researchers to explore this possibility and to include additional explanatory variables not measured here (e.g., cognitive elaboration) in future GWL research.

These findings have substantial legal implications regarding the potential implementation of GWLs in the US. When the Court of Appeals for the DC Circuit sided with the tobacco companies’ objections to mandatory GWLs, the ruling majority placed a premium on the labels’ ability to communicate information about smoking risks. The ruling maintained that the FDA-proposed labels “are unabashed attempts to evoke emotion...they certainly do not impart purely factual, accurate, or uncontroversial information to consumers” (“RJ Reynolds Tobacco Co. v. Food and Drug Admin,” 2012). However, recent evidence shows that smokers perceive pictorial warnings to be no less informative than text-only warnings, rate pictorial warnings as only slightly more emotion-inducing, and report feeling more intense negative affect for warnings they perceive as informative (Popova et al., 2017). Our evidence paints a similar picture about the complex interplay between feelings and beliefs, suggesting that emotional and cognitive responses to GWLs are not mutually exclusive processes. The emotional responses evoked by GWLs serve to promote acceptance of risk beliefs among

smokers and nonsmokers—a key criterion for the courts as they considered the legality of GWLs (Peters et al., 2016).

Limitations

First, our design did not allow us to examine whether label effects sustain beyond an immediate post-test. Second, we exposed participants to nine different labels in a single (mobile) laboratory setting, so it is unclear if the findings would have been different had participants been repeatedly exposed to labels over time or had they been exposed in a more naturalistic context. Third, findings may not generalize to the broader U.S. population given our use of convenience (but purposive) samples of low SES participants. Fourth, recent risk theorizing distinguishes three types of risk processing: deliberative, affective, and experiential (Ferrer, Klein, Persoskie, Avishai-Yitshak, & Sheeran, 2016). We did not examine experiential risk in this paper, which involves gut-level responses to risk. We encourage researchers to explore these kinds of gut-level reactions in future work. Fifth, affect can serve a framing or spotlight function by privileging certain kinds of information related to the affect's source (Nabi, 2003; Peters et al., 2006). Previous research suggests negative affect can serve such a function in the context of GWLs (Cho et al., 2017; Evans et al., 2015), but we were unable to test this mechanism here. Finally, it is uncertain from our design whether labels are teaching consumers about smoking's harms (i.e., instilling new beliefs) or simply reminding consumers of what they already know.

Conclusions

Research on the psychological effects of GWLs has demonstrated the centrality of affective responses in shaping behavioral intentions and expectations. We offer important new evidence on the interplay between emotions and cognitions in shaping these responses among adult smokers and non-smoking (but at-risk) youth—both recruited from low-income communities. We find evidence that label-induced negative affect (a) promotes beliefs about smoking's harms (adults and youth) and (b) can directly motivate quit intentions (adults). Findings challenge the argument that FDA-proposed GWLs are emotional and therefore not informative; to the contrary, GWLs appear informative precisely *because* they are emotional.

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Figure 1. Sample stimuli for experiment 1 (graphic)

Caption: From left to right: control, Surgeon General's warning, FDA-proposed text-only, FDA-proposed text with image (black/white), FDA-proposed text with image (color)

Figure 2. Sample stimuli for experiment 2 (size)
Caption: From left to right: control, 30%, 50%.

Figure 3. Path models for best fitting model across the four datasets

Caption: (a) Graphic experiment (adults), (b) size experiment (adults), (c) graphic experiment (youth), (d) size experiment (youth). # p .10. * p .05. ** p .01. *** p .001. Solid paths are significant; dashed paths are not significant.

Table 1.
Sample demographics

Caption: Percentages are based on the number of respondents with non-missing data for that variable.
WIC=Special Supplemental Nutrition Program for Women, Infants, and Children. SNAP=Supplemental Nutrition Assistance Program.

	Means (SD) or N's (valid %)			
	Experiment 1 (graphic)		Experiment 2 (size)	
	Adults	Youth	Adults	Youth
Age	39.95 (13.27)	12.57 (1.01)	40.70 (13.85)	12.54 (.99)
Sex				
Male	198 (64.3%)	150 (45.3%)	133 (55.9%)	107 (45.3%)
Female	108 (35%)	171 (51.7%)	105 (44.1%)	123 (52.1%)
Prefer not to say	2 (0.6%)	10 (3%)	0 (0%)	6 (2.5%)
Hispanic	30 (9.8%)	41 (12.1%)	40 (16.9%)	55 (23.2%)
Race				
White	217 (69.3%)	216 (63.5%)	149 (62.6%)	75 (31.6%)
Black	83 (26.5%)	72 (21.2%)	76 (31.9%)	119 (50.2%)
Other	38 (12.1%)	59 (17.4%)	30 (12.6%)	59 (24.9%)
Smoking variables				
Nicotine dependence (range 1–10)	5.39 (2.34)	-	5.10 (2.28)	-
Tried to quit in past 12 months	169 (54.5%)	-	141 (59.2%)	-
Live with a smoker	-	181 (53.2%)	-	104 (43.9%)
Tried a cigarette	-	28 (8.2%)	-	20 (8.5%)
Colorblind	33 (10.7%)	24 (7.1%)	16 (6.7%)	20 (8.5%)
Income (total yearly household)				
\$0 - \$9,999	135 (44.4%)	-	93 (39.7%)	-
\$10,000 - \$19,999	88 (28.9%)	-	56 (23.9%)	-
\$20,000+	81 (26.6%)	-	85 (36.3%)	-
Education				
Less than high school diploma	118 (38.3%)	-	91 (38.2%)	-
High school graduate	190 (61.7%)	-	147 (61.8%)	-
Some college	77 (25%)	-	59 (24.8%)	-
College graduate	26 (8.4%)	-	31 (13%)	-
Benefits program recipient				
Emergency food	184 (59.7%)	-	101 (42.4%)	-
WIC	52 (16.9%)	-	32 (13.4%)	-
SNAP	220 (71.4%)	-	151 (63.4%)	-
N	313	340	238	237

Table 2.

Fit indices for hypothesized models (adults)

Caption: Bolded values indicate acceptable fit values for each index.

Hypothesis	Model	Experiment 1 (graphic)				Experiment 2 (size)			
		χ^2 (df)	CFI	RMSEA [90% CI]	SRMR	χ^2 (df)	CFI	RMSEA [90% CI]	SRMR
1, 2	GWLS $\rightarrow$ risk beliefs $\rightarrow$ intention / GWLS $\rightarrow$ negative affect $\rightarrow$ intention	9.19(3) $p < .05$	.88	.08 [.02, .14]	.07	18.09(3) $p < .001$	.87	.15 [.09, .22]	.11
3	GWLS $\rightarrow$ risk beliefs $\rightarrow$ negative affect $\rightarrow$ intention	34.73(5) $p < .001$	.41	.14 [.10, .18]	.09	67.82(5) $p < .001$	.45	.23 [.19, .28]	.09
4	GWLS $\rightarrow$ negative affect $\rightarrow$ risk beliefs $\rightarrow$ intention	7.66(5) $p = .18$	.95	.04 [.00, .10]	.08	18.14(5) $p < .01$	.88	.11 [.06, .16]	.12
5	GWLS $\rightarrow$ negative affect $\rightarrow$ intention / GWLS $\rightarrow$ negative affect $\rightarrow$ risk beliefs $\rightarrow$ intention	4.56(4) $p = .34$	.99	.02 [.00, .09]	.03	1.25(4) $p = .87$	1.00	.00 [.00, .05]	.01

Table 3.

Fit indices for hypothesized models (youth)

Caption: Bolded values indicate acceptable fit values for each index.

Hypothesis	Model	Experiment 1 (graphic)				Experiment 2 (size)			
		χ^2 (df)	CFI	RMSEA [90% CI]	SRMR	χ^2 (df)	CFI	RMSEA [90% CI]	SRMR
1, 2	GWLS $\rightarrow$ risk beliefs $\rightarrow$ susceptibility / GWLS $\rightarrow$ negative affect $\rightarrow$ susceptibility	11.44(3) $p=.01$	.74	.02 [.04, .15]	.08	14.94(3) $p<.01$	.67	.13 [.07, .20]	.09
3	GWLS $\rightarrow$ risk beliefs $\rightarrow$ negative affect $\rightarrow$ susceptibility	16.83(5) $p<.01$	.64	.09 [.04, .13]	.06	20.50(5) $p=.001$	.57	.12 [.07, .17]	.04
4	GWLS $\rightarrow$ negative affect $\rightarrow$ risk beliefs $\rightarrow$ susceptibility	3.95(5) $p=.56$	1.00	.00 [.00, .07]	.03	4.59(5) $p=.47$	1.00	.00 [.00, .09]	.02
5	GWLS $\rightarrow$ negative affect $\rightarrow$ susceptibility / GWLS $\rightarrow$ negative affect $\rightarrow$ risk beliefs $\rightarrow$ susceptibility	3.40(4) $p=.49$	1.00	.00 [.00, .08]	.02	4.51(4) $p=.34$	.99	.02 [.00, .11]	.02