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Responses of young adults to graphic warning labels for cigarette packages

Linda D. Cameron[1], **Jessica K. Pepper**[2,3], and **Noel T. Brewer**[2,3]

[1]Psychological Sciences, School of Social Science, Humanities, and the Arts, University of California, Merced. California, USA

[2]Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

[3]Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

Abstract

Background—In 2010, the US Food and Drug Administration (FDA) proposed a series of 36 graphic warning labels for cigarette packages. We sought to evaluate the effects of the labels on fear-related emotions about health consequences of smoking and smoking motivations of young adults.

Methods—We conducted an experimental study in 2010–2011 with 325 smokers and non-smokers ages 18–30 years whom we recruited through community distribution lists in North Carolina and through a national survey company. Each participant viewed 27 labels (18 of the proposed labels with graphic images and text warnings and 9 with text-only warnings) in a random order, evaluating each label on understandability and its effects on fear-related reactions and discouragement from wanting to smoke.

Results—Respondents found most of the proposed labels easy to understand. Of the 36 labels, 64% induced greater fear-related reactions and 58% discouraged respondents from wanting to smoke more than the corresponding text-only labels did. Labels with the greatest effects had photographs (as compared with drawings or other art graphics) or depicted diseased body parts or suffering or dead people. In almost every comparison, smokers reported lower fear-related reactions and feeling less discouraged from wanting to smoke relative to non-smokers.

Conclusions—Most of the proposed labels enhanced fear-related reactions about health consequences of smoking and reduced motivations to smoke relative to text-only labels, although

Correspondence to: Dr Linda D. Cameron, Psychological Sciences, School of Social Science, Humanities, and the Arts, University of California, Merced. California, USA; lcameron@ucmerced.edu.

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some had larger effects than others. All but one of the nine warning labels recently adopted by the FDA enhanced fear-related reactions and reduced smoking motivations.

INTRODUCTION

Smoking is the leading cause of death in the USA[1] and the rest of the developed world.[2] Tobacco control efforts focus on discouraging smoking initiation by non-smokers and encouraging smokers to stop. In many countries, these efforts include policies requiring warning messages on tobacco products. The WHO's Framework Convention on Tobacco Control (FCTC) calls for the implementation of large warning labels on tobacco products, preferably with graphic images that communicate the potential consequences of smoking.[3, 4] To date, more than 45 countries require warning labels with graphic images.[4]

Message processing and persuasion theories suggest that graphic warnings can discourage smoking when viewers understand the messages they are conveying and when the warnings arouse fear and worry about the consequences.[5–8] Cognition and neuroscience research demonstrates that imagery-based information can elicit faster processing, stronger emotional responses, stronger attitude development and easier recall than text-based information.[9, 10] Thus, graphic warning labels may have a greater impact on smoking motivations than do text-based labels that convey the same messages, particularly if they provoke feelings of worry and fear about harm.[5, 7, 11] Consistent with this theoretical and empirical base, a growing body of research supports the use of graphic warning labels over text-only labels for cigarettes.[12] Compared with text-only warning labels, graphic warning labels can evoke stronger emotional responses and increase motivations to not smoke or attempt quitting.[4, 13–20]

The 2009 Family Smoking Prevention and Tobacco Control Act calls for the implementation of graphic warning labels on cigarette packaging and advertisements in the USA. In November 2010, the Food and Drug Administration (FDA) made available to the public a set of 36 proposed warning labels from which they planned to select 9 labels for use. It is important to understand the potential impact of these labels, especially among young adults as they may be less aware or concerned about the health consequences of smoking relative to older adults.[21] Moreover, non-smoking young adults represent a vulnerable group for smoking initiation because many smokers begin smoking regularly when they are in this age range.[22–26]

The graphic warning labels could have a greater impact for non-smokers than for smokers because non-smokers may have less personal experience with smoking, and contemplating the potential harms of smoking and their smoking choices are not constrained by addiction. Non-smokers are likely to view the FDA warnings because Tobacco Control Act requires them to be displayed not just on cigarette packs but on all cigarette advertising, including posters and magazine advertisements. These tobacco promotional materials are not benign; for example, exposure to 'point of sale' advertising (eg, posters at convenience stores) is associated with increased smoking susceptibility and initiation among non-smokers.[27]

We conducted an experimental study with young adults (18–30 years old) in the USA to examine their responses to the 36 proposed warning labels, with particular attention to the nine labels ultimately selected by the FDA. We evaluated which labels, relative to text-only labels, are more easily understood and produce greater fear-related reactions and discouragement from wanting to smoke. We also examined whether non-smokers have stronger reactions of fear-related emotions and feeling discouraged from wanting to smoke than do smokers. Finally, we explored which types of images in graphic labels are most likely to reduce smoking motivations. This analysis follows preliminary research guided by theory on mental models of health risks[5, 28] that evaluated how imagery elements influenced responses by community members to graphic warning labels proposed for use in the European Union.[29] Consistent with the theory that individuals are predisposed to encode and process information about the symptoms and identity (including prototypical individuals affected by the threat) labels depicting diseased body parts (eg, neck tumors), dead or suffering people, and children or babies were more likely than other labels to be viewed as effective in discouraging people from smoking. In contrast, use of art graphics (eg, drawings rather than photographs) and metaphors (eg, a wrinkled apple to depict ageing skin) decreased the likelihood of a label being perceived as effective, potentially due to the lower realism; medical equipment, an image used to depict severity of health consequences, had little impact on perceived effectiveness. We coded the FDA's proposed labels for these image categories and an additional category of unpleasant smoking experiences, which emerged as a common theme and provided smoking cues that could potentially trigger urges to smoke.[30]

METHODS

Participants

The University of North Carolina Institutional Review Board approved the study. Eligible adults, who were 18–30 years old and residing in the USA, participated in the study from December 2010 to January 2011 between the FDA's release of the warning labels (November 2010) and their announcement of the final selection of labels (June 2011). The study included a convenience sample of adults who responded to email announcements sent through community distribution lists managed by the University of North Carolina and to posts on a national website service for recruiting survey respondents (Amazon Mechanical Turk or MTurk). Participants received a $5 gift certificate or payment through MTurk.

Design

The study utilised a split-plot design with smoker status (smoker or non-smoker) as the between-subjects variable and warning label (graphic vs text-only comparison) as the within-subjects variable. Each participant viewed 18 of the 36 proposed labels, which the FDA grouped into nine warning categories,[31] and nine text-only labels, each with the warning statement for one of the nine categories.

Materials and procedure

Because of the large number of labels, we developed two versions of an online questionnaire (Versions A and B), each of which contained 18 of the 36 proposed labels and the nine text-

only labels. The labels are presented in the online supplementary materials. The text-only labels were designed to control for text message, label size and the use of red, black and white colours in the backgrounds and text of the proposed graphics labels. These text-only labels presented the warning statements in white and red text against a black background. Each label appeared on the face of an image of a cigarette pack and comprised top 50% of the front panel; the word 'Brand' appeared below the label.

After completing the measures of smoking behaviour and demographic characteristics, participants randomly received questionnaire Version A or Version B and viewed 27 labels in random order. They rated each label on understandability, how much it aroused fear-related reactions and how much it discouraged them from wanting to smoke. On average, participants completed the survey in approximately 16 min.

Measures

Smoking behaviour—Smoking status was assessed with two items, 'How often do you smoke now?' (response options were: never, I am not a smoker; less than once a month; at least once a month; at least once a week; and at least once a day) and 'Have you smoked cigarettes 100 or more times in your life?' (response options were: yes and no). Using widely accepted definitions of smoking status,[32] we categorised participants as smokers if they reported non-daily or daily smoking (less than once a month through at least once a day). We categorised participants as former smokers if they were non-smokers who had smoked cigarettes 100 times or more.

Understandability—Participants responded to the question 'How would you describe the message conveyed by this label?' by rating their endorsement of two items: 'The message is easy to understand' and 'The message is confusing'. Each had response options of not at all (coded as 1), slightly (2), somewhat (3) or a great deal (4). We reverse-scored the latter item before averaging the ratings. Across the 36 graphic labels, the average correlation of the two items was moderate; mean r=0.65.

Fear-related reactions—A short measure, adapted from a measure developed by Brown and Smith[33] for a young adult sample, included two items: 'How much does this image make you feel worried?' and 'How much does this image make you feel scared?' Response scales ranged from not at all (1) to extremely (7). We averaged the two ratings (mean r=0.94 across the 36 labels) to generate scores. These items are also similar to those used to measure emotional reactions to warning labels in samples that included young adults.[34–36]

Discouraged from smoking—The item 'How much does this label discourage you from wanting to smoke cigarettes?' had response options ranging from not at all (1) to very much (5).

Image themes—To explore the potential impact of specific images, we coded the labels according to seven *image themes* derived from prior research on graphic warning labels.[16] These themes were: (1) diseased body parts; (2) suffering or dead people; (3) children or babies; (4) art graphics (image with graphic design elements or drawings rather than a photograph); (5) metaphors (symbolic representations; eg, a puppet on strings to convey

addiction); (6) medical equipment (eg, an oxygen mask); and (7) unpleasant smoking experiences (people smoking in unpleasant situations or eliciting aversive reactions from others). Some labels fit into multiple image theme categories and were coded accordingly. Two raters independently coded the labels for image themes. Inter-rater reliability was 100%.

Analyses

We conducted preliminary analyses (correlations and t tests) to test associations of age and sampling groups (those recruited through North Carolina distribution lists vs MTurk) with the dependent measures of understandability, fear-related reactions and discouragement from wanting to smoke. We also conducted preliminary analyses of variance (ANOVA) to test for differences between current smokers, former smokers and non-smokers on these dependent measures.

We evaluated the understandability of the proposed graphic warning labels by examining the sample means of the understandability scores. We used a series of 2×2 split-plot ANOVAs to test the effects of labels (each proposed graphic warning label vs its corresponding text-only label; a within-subjects variable) and smoker status (smoker vs non-smoker; a between-subjects variable) on fear-related reactions scores. We repeated these ANOVAs for ratings of discouragement from wanting to smoke. Preliminary split-plot ANOVA for fear-related reactions and discouragement from wanting to smoke included demographic variables as covariates where they were statistically significant predictors to determine whether they should be included in the final analyses.

We calculated the average effect sizes for the image themes' effects on ratings of feeling discouraged from smoking (using partial eta squared or η_p^2, a measure of the variance in an outcome explained by a predictor[37]). These seven effect sizes were compared to identify which image themes elicited the largest effects on smoking motivations. We conducted the analyses using SPSS V.19 in 2012. Analyses were two-tailed with a critical $p<0.01$.

RESULTS

Sample characteristics

The sample included 325 participants from 43 states across the nation; 111 (34.3%) were recruited through community distribution lists and 214 (65.7%) were recruited through MTurk. Most participants were ages 18–21 (39.1%) or 22–25 (48.3%). Preliminary ANOVAs revealed that age and sampling groups were not related to the dependent variables of understandability, fear-related reactions and discouragement from wanting to smoke. About 17 participants (5.2%) were former smokers. Preliminary ANOVAs indicated that former smokers did not differ from non-smokers on any of the dependent variables, and the patterns of differences between former and current smokers were similar to those between non-smokers and current smokers. As the small number of former smokers does not provide sufficient power to draw conclusions about group differences, we dropped former smokers from the remaining analyses. Table 1 presents the sociodemographic characteristics of non-smokers and smokers. Relative to non-smokers, smokers tended to be older by about 1 year;

a higher proportion were men, employed in full-time or part-time work and married; and a lower proportion were students. Preliminary split-plot ANCOVAs included these variables as covariates where they were statistically significant predictors. Their inclusion did not alter any of the patterns of Label and Smoker Status effects, and so they were omitted from the final analyses.

Understandability

Participants generally found the proposed graphic warning labels easy to understand (see table 2). Ratings of understandability were generally high, with mean ratings ranging from 3.50 to 4.00 for 28 of the 36 labels. Labels with mean ratings lower than 3.50 included three of the four labels from the 'Cigarettes are Addictive' warning category (Cigarette Injection, Red Puppet and Woman in Rain), one label from the 'Cigarettes Cause Strokes and Heart Disease' category (Red Lightning with Heart), one label from the 'Smoking Causes Fatal Lung Disease in Non-smokers' category (Woman Crying) and all three labels in the 'Quitting Smoking Now Greatly Reduces Serious Risk to Your Health' category (Cigarettes in Toilet Bowl, Woman Blowing Bubble, Man in 'I Quit' T-Shirt). The nine labels ultimately selected by the FDA (presented in bold) had high understandability scores with the exceptions of Woman Crying and Man in 'I Quit' T-Shirt, although the latter had the highest rating of the labels in its warning category. Across the 36 proposed labels, understandability tended to be modestly related to higher fear-related reactions (average $r=0.24$; range=0.09–0.41; at $r=0.24$, $p<0.01$) and greater discouragement from wanting to smoke (average $r=0.27$; range=0.19–0.43; at $r=0.27$, $p<0.01$).

Fear-related reactions

Table 3 presents the fear-related reactions means (SDs) and image themes for the graphic warning labels, with the nine labels ultimately selected by the FDA in bold. Overall, 25 of the 36 graphic warning labels induced greater fear-related reactions compared with their corresponding text-only labels. Many of these labels had large effects. Figure 1 depicts the eight labels with the greatest impact on fear-related reactions based on the ranking of effect sizes. Notably, these labels consisted primarily of images depicting diseased body parts (four labels) and suffering or dead people (four labels).

Eleven labels induced comparable fear-related reactions relative to the text-only labels. These labels consisted primarily of images with art graphics (five labels), metaphors (three labels), unpleasant smoking experiences (three labels) and medical equipment (one label). Two graphic labels induced lower fear-related reactions than their text-only versions; both focused on the reassuring message that 'quitting smoking now reduces serious risk to your health' and used metaphors: Man in 'I Quit' T-Shirt and Woman Blowing Bubble.

The labels selected by the FDA induced more fear-related reactions than their corresponding text-only labels did, with the exception of Man in 'I Quit' T-Shirt. Five of these labels had the largest effects on fear-related reactions within their respective warning categories.

For almost every label, non-smokers reported greater fear-related reactions than smokers did. The only exceptions were that non-smokers and smokers gave comparably low ratings for the Man in 'I Quit' T-Shirt and Woman Blowing Bubble labels.

Label × Smoking Status interaction effects emerged as statistically significant for only four labels. For two labels, the graphic contents increased fear-related reactions for non-smokers (p's<0.01) but not for smokers (p's>.20). These labels were: Smoke Approaching Baby, F(1, 144)=9.45, p<0.01; η_p^2=0.06; and Pacifier in Ashtray, F(1, 144)=8.03, p<0.01, η_p^2=0.06. In contrast, two labels (relative to the text-only label) induced greater increases in fear-related reactions for smokers than they did for non-smokers: Red Cigarette Burning, F (1, 146)=9.39, p<0.01, η_p^2=0.06; and Cancerous Lesion on Lip, F(1, 144)=7.26, p<0.01, η_p^2=0.06. Whereas smokers reported lower fear-related reactions than non-smokers did to the text-only label (M=2.95 vs M=4.14, respectively; p<0.001); smokers and non-smokers reported comparably high fear-related reactions to these graphic labels: for Red Cigarette Burning, M=3.63 vs M=4.25, p>0.10; and for Cancerous Lesion on Lip, M=4.51 vs M=4.91, p>0.25. Across the 36 labels, fear-related reactions were associated with greater discouragement from wanting to smoke (average r=0.69, range=0.65–0.78; at r=0.69, p<0.001).

Discouragement from wanting to smoke

Overall, 22 of the 36 graphic warning labels discouraged participants from wanting to smoke more than corresponding text-only labels did (see table 4). Figure 1 depicts the mean ratings for the eight labels that had the greatest impact based on the ranking of effect sizes. Notably, these were the same eight labels that had the greatest impact on fear-related reactions.

Except for the Red Puppet label, all of the graphic labels that failed to enhance fear-related reactions relative to their text-only versions also failed to discourage respondents from smoking more than the text-only labels. Girl Crying, Hand with Oxygen Mask and Red Coffin also failed to discourage wanting to smoke more than the text-only versions did. One graphic label was less discouraging than its text-only version: Man in 'I Quit' T-Shirt.

Once again, the ineffective labels had images consisting primarily of art graphics (five labels), metaphors (four labels), unpleasant smoking experiences (three labels) and medical equipment (two labels), although one label depicted a suffering person and a child.

With the exception of Man in 'I Quit' T-Shirt, the labels that the FDA selected were more effective than the text-only labels in discouraging respondents from smoking. Five of these labels had the largest effects of those within their respective warning categories.

Analyses revealed substantial differences between non-smokers and smokers in their reports of feeling discouraged from smoking in response to the labels. Non-smokers reported relatively greater discouragement in response to all labels. None of the Label×Smoking Status interaction effects reached statistical significance.

Evaluations of the average effect sizes for labels within the image theme categories revealed that the image theme that most discouraged smoking was diseased body parts (average η_p^2=0.36), followed by suffering or dead people (average η_p^2=0.14), children or babies (average η_p^2=0.11) and medical equipment (average η_p^2=0.08). Image themes with the

smallest effect sizes were unpleasant smoking experiences (average $\eta_p^2=0.05$), art graphics (average $\eta_p^2=0.05$) and metaphors (average $\eta_p^2=0.04$).

DISCUSSION

Three key findings emerged from this study of the effects of the proposed graphic warning labels. First, the 36 proposed labels were easily understood, and many had greater effects than text-only labels on fear-related reactions and smoking motivations, including all but one of the nine labels that the FDA finally selected. Overall, 69% of them induced relatively greater fear-related reactions about the health consequences of smoking and 61% induced relatively greater discouragement from wanting to smoke. Second, the graphic warning labels compared with text-only labels induced greater fear-related reactions and discouragement for both young adult smokers and non-smokers, but the effects were generally stronger for non-smokers. Third, labels with the greatest effects on discouragement from wanting to smoke generally included photographs of diseased body parts, suffering or dead people or children or babies, whereas labels with minimal effects generally included images consisting of art graphics, metaphors or depictions of unpleasant smoking experiences. These latter findings converge with evidence that labels with graphic depictions of disease have stronger effects on emotional reactions and smoking motivations than do images of human suffering or symbolic images.[15, 17]

These results complement findings from two recent evaluations of the 36 proposed warning labels, indicating that many labels elicited stronger emotions or were perceived as more effective relative to text-only labels.[16, 34] Similar to Nonnemaker and colleagues,[34] we also found no evidence that the graphic labels in the warning category, ‘Quitting smoking now greatly reduces serious risk to your health,’ affects emotional reactions and smoking motivations, and we found that the Woman Blowing Bubble image decreases motivations to not smoke. Hammond and colleagues[16] also identified elements associated with greater perceived effectiveness, including graphic images of disease or suffering as well as real people (vs comic book figures), a quitline number (vs no number), full colour (vs black and white) and personal information (eg, the sufferer’s name and narrative).

The present study differs from the prior studies in several ways. First, the prior studies included smokers (all ages), and either non-smokers ages 16–18 or susceptible non-smokers ages 13–17. In contrast, this study included the vulnerable and large group of young adult non-smokers. Our findings add new information that the warning label effects extend to non-smokers and even have stronger effects on fear-related reactions and discouragement from smoking for non-smokers than for smokers. Nonnnemaker and colleagues used a between-subjects design in which each participant viewed only one label, which enabled them to test the effects of each label on intentions to quit or to start smoking. Participants in the present study viewed multiple labels, and this experience may reflect the exposure to multiple (although potentially not as many) labels that community members will have when the labels are implemented and disseminated through media. Nonnemaker and colleagues also assessed general quit intentions (eg, ‘How likely do you think it is that you will try to quit smoking within the next 30 days?’), whereas this study focused specifically on how the

labels affected motivations to not smoke. This distinction is important given that the previous study did not obtain evidence that the warning labels had much impact on smoking intentions; only three labels had reliable effects on smoking intentions for one of their subsamples, and those effects were small. In contrast, we found reliable and typically medium or large effects of the labels in discouraging respondents from wanting to smoke, suggesting that the labels may influence immediate smoking motivations.

Finally, our study added complementary evidence to findings from the previous studies in that we compared the graphic labels to text-only labels that were similar in size and the use of red, black and white colour fonts in order to provide a strong test of the relative effects of the graphic images. The FCTC calls for the implementation of large warning labels on tobacco products, and the present findings support the use of the graphic images over large, text-only labels. Nonnemaker and colleagues provided complementary evidence on the size of proposed labels' effects on emotional responses relative to text-only statements in the size and font of current labels.

Several aspects of the study warrant comment. While the study sample included young adults from across the USA, recruitment through university-based distribution lists and MTurk means that the generalisability of the findings remains to be established. Use of these recruitment methods was necessary given the time constraints created by the need to complete the survey before the FDA selected the final set of labels and announced them to the nation. MTurk has been found to yield high-quality data, as reflected by such indicators as high-scale reliabilities that are comparable to those obtained through more traditional methods,[38] and it provided a diverse sample of young adults. Further research is needed to evaluate the effects of the labels for those communities not well-represented by this sample, particularly Hispanics and Latinos and those without high school diplomas.

The study utilised a heterogeneous sample of young adults ages 18–30, and it is possible that some subgroups could react differently to the graphic warning labels. For example, non-smokers at the older end of the spectrum may be less likely than younger non-smokers to initiate smoking in the future.[39] Although analyses revealed no age differences in immediate worry and motivational reactions to the labels, warning labels discouraging smoking may, nevertheless, have less impact on smoking initiation rates for older non-smokers than for younger non-smokers. Further studies utilising larger samples and additional measures of subsequent smoking behaviour are needed to examine age-related differences in immediate and longer term emotional, motivational and behavioural reactions to the labels.

One limitation is that participants viewed the warning labels on computers rather than in tactile, real-world settings. Interacting with tobacco warnings in naturalistic settings might lead to different (potentially increased) effects on fear-related reactions and discouragement from smoking. Although the use of multiple comparisons increases the risk of Type 1 error, the many large effect sizes and highly consistent patterns for the Label and Smoking Status main effects suggest that they are not due to chance. We split the graphic labels into two sets to reduce participant burden, leaving open the possibility that the other warnings in each set may have differentially influenced how each warning was rated. The random orderings should have minimised these effects and no set effects were observed for the text-only

labels, but an alternative approach would be to randomise participants to 18 of the 36 labels. The few Label×Smoking Status interaction effects, which had small effect sizes and inconsistent patterns, should be interpreted with caution. The general absence of significant interaction effects suggests that the labels' main effects tend to be comparable for young adult smokers and non-smokers.

At the time of writing, the implementation of the labels was blocked by ongoing litigation (*R.J. Reynolds Tobacco Co.* vs *U.S. FDA*, No. 11–1482 (D.D.C.), on appeal, No. 11-5332 (D.C. Cir.). The original court decision found that requiring tobacco companies to display the labels violated their right to free speech. The ruling was upheld on appeal, and the FDA subsequently petitioned for its review by a large panel of judges. This litigation underscores the continuing need for research on the effects of the proposed warning labels and other graphic labels on knowledge and appreciation of the health consequences of smoking and on decisions to initiate, continue or quit smoking. This research also continues to inform the decisions of other countries regarding the implementation of graphic warnings as well as the development and selection of specific warnings.

In conclusion, the present findings indicate that, for young adult smokers and non-smokers, many of the proposed warning labels were easy to understand, enhanced fear-related reactions about the health consequences of smoking and discouraged them from wanting to smoke. The findings point to the types of images that may have the greatest effects in discouraging smoking: those with photographs of diseased body parts, suffering people, dead people, children and babies. The study also identified images least likely to influence smoking motivations: those with art graphics, metaphors or unpleasant smoking experiences. These findings can be useful in guiding the development of new labels in the future. The Family Smoking Prevention and Tobacco Control Act permits changes in the labels if they promote greater appreciation of the risks associated with smoking and reduce habituation to the warning labels that are in use. Further research could use larger samples of warning labels to provide sufficient power to test for the independent associations of the image themes with the variance in reactions accounted for by the graphic label effects. This research can also evaluate differences in use of images within a warning category, such as the relative influences of an image of a child or baby versus an adult in labels about the consequences of secondhand smoke. Continued research is needed to further delineate the types of graphic images that have the greatest impact on risk perceptions and smoking motivations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What this paper adds

- In 2010, the US Food and Drug Administration (FDA) proposed 36 new graphic warning labels for cigarette packages. This experimental study provides evidence that most of these labels, including all but one of the nine labels the FDA finally selected in 2011, effectively induced greater fear-related reactions and discouragement from wanting to smoke than corresponding text-only labels did for a sample of young adults in the USA.
- The graphic warning labels compared with text-only labels induced greater fear-related reactions and discouragement for both smokers and non-smokers, but these effects were stronger for non-smokers.
- The findings suggest that warning labels with photographs and images of diseased body parts, corpses or suffering people are likely to be more impactful than labels with art graphics, metaphorical images or depictions of unpleasant smoking experiences in eliciting fear-related reactions and discouraging viewers from wanting to smoke.

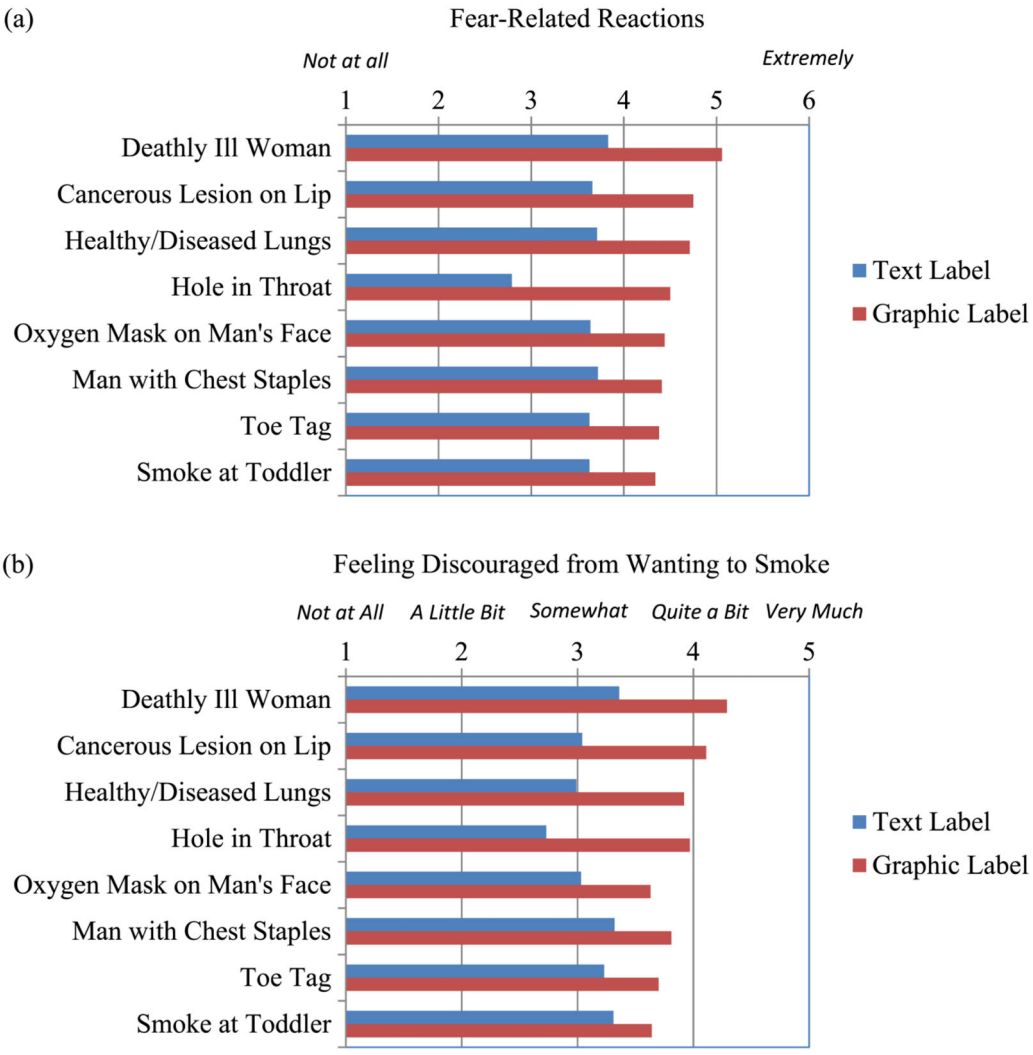

Figure 1.

The eight graphic warning labels with the greatest impact on: (A) fear of harms and (B) feeling discouraged from wanting to smoke.

Table 1

Sociodemographic characteristics of the sample (N=308)

Characteristic	Non-smokers, n (%) (n=195; 63.3%)	Smokers, n (%) (n=113; 36.7%)	Smoker status effect
Age, mean (SD)	22.19 (3.18)	23.44 (3.23)	$F(1,307)=10.76^{**}$
Gender			$\chi^2=6.23^{*}$
Female	144 (73.8)	68 (60.2)	
Male	51 (26.2)	45 (39.8)	
Race/ethnicity			$\chi^2=12.11^{**}$
Non-hispanic white	138 (70.4)	100 (87.0)	
Non-hispanic black	25 (12.8)	4 (3.5)	
Asian	30 (15.3)	6 (5.3)	
Hispanic	12 (6.1)	5 (4.4)	
Other	4 (2.5)	7 (6.2)	
Education level			$\chi^2=7.57$
Some high school	0 (0.0)	1 (0.9)	
High school graduate or equivalent	32 (16.4)	25 (22.0)	
Technical or trade school	2 (1.0)	4 (2.5)	
Some college	83 (42.6)	49 (43.4)	
College graduate	78 (40.0)	34 (30.0)	
Employment status			$\chi^2=8.62^{*}$
Full time	39 (20.0)	39 (34.5)	
Part time	70 (35.9)	36 (31.9)	
No	86 (63.5)	38 (33.6)	
Student status			$\chi^2=13.58^{**}$
Full time or part time	137 (70.2)	55 (50.4)	
Not a student	58 (29.7)	57 (49.6)	
Marital status			$\chi^2=11.34^{**}$
Single–never married	153 (78.5)	73 (65.2)	
Married or living with partner	42 (21.5	35 (31.2)	
Separated or divorced	0 (0.0)	4 (3.6)	

* $p<0.05$,

** $p<0.01$.

Table 2

Graphic warning labels included in questionnaire versions A and B and their understandability ratings

	Questionnaire version A		Questionnaire version B	
Warning category	**Label**	**Understandability, mean (SD)**	**Label**	**Understandability, mean (SD)**
Cigarettes are Addictive	**Hole in Throat**	3.58 (0.72)	Red Puppet	3.41 (0.78)
	Cigarette Injection	3.32 (0.88)	Woman in Rain	3.15 (0.94)
Tobacco Smoke Can Harm Your Children	**Smoke Approaching Baby**	3.77 (0.56)	Smoke at Toddler	3.74 (0.50)
	Smoke at Baby	3.80 (0.49)	Girl Crying	3.59 (0.69)
	Girl with Oxygen Mask	3.59 (0.68)	Child Lettering	3.66 (0.50)
Cigarettes Cause Fatal Lung Disease	Toe Tag	3.74 (0.56)	**Healthy/Diseased Lungs**	3.68 (0.57)
	Lungs Full of Cigarettes	3.60 (0.70)	Doctor with X-Ray	3.60 (0.64)
Cigarettes Cause Cancer	Deathly Ill Woman	3.82 (0.45)	Red Cigarette Burning	3.67 (0.55)
	White Cigarette Burning	3.70 (0.59)	**Cancerous Lesion on Lip**	3.73 (0.59)
Cigarettes Cause Strokes And Heart Disease	Hand With Oxygen Mask	3.52 (0.68)	Man Pain-Hand on Chest	3.68 (0.55)
	Red Lightning with Heart	3.41 (0.78)	**Oxygen Mask Man's Face**	3.73 (0.52)
Smoking During Pregnancy Can Harm Your Baby	Pacifier and Ashtray	3.74 (0.54)	**Baby in Incubator**	3.72 (0.52)
Smoking Can Kill You	**Man with Chest Staples**	3.68 (0.62)	Man in Casket	3.74 (0.53)
	Red Coffin with Body in Black	3.71 (0.66)	Cigarettes=RIP	3.66 (0.59)
Tobacco Smoke Causes Fatal Lung Disease in Non-smokers	**Woman Crying**	3.36 (0.80)	Woman Smoke at Man	3.55 (0.69)
	Graveyard	3.58 (0.68)	Man Hands Up and Smoke	3.53 (0.71)
	Man Smoke at Woman	3.65 (0.67)		
Quitting Smoking Now Greatly Reduces Serious Risk To Your Health	Cigarettes in Toilet Bowl	3.24 (0.90)	Woman Blowing Bubble	2.82 (0.98)
			Man in 'I Quit' T-Shirt	3.43 (0.73)

Warning categories are those defined by the Food and Drug Administration (FDA). Label names are those used by Nonnemaker *et al.*[34] Understandability scores range from 1 (not at all) to 4 (a great deal). The labels selected by the FDA in June 2011 appear in bold.

Table 3

Fear-related reactions induced by graphic versus text warning labels for non-smokers (n=195) and smokers (n=113)

				Label effect				Smoker status effect	
Label	**Image themes**	**Graphic label M (SD)**	**Text label M (SD)**	**F**	η_p^2	**Non-smokers M (SD)**	**Smokers M (SD)**	**F**	η_p^2
Cigarettes are Addictive									
Hole in Throat	D	4.50 (2.18)	2.79 (1.82)	98.56***	0.42	4.15 (1.91)	2.76 (1.85)	23.81***	0.15
Cigarette Injection	M, A	3.54 (2.14)	2.79 (1.82)	20.85***	0.13	3.72 (1.98)	2.25 (1.59)	26.24***	0.16
Red Puppet	M, A	3.03 (1.69)	2.79 (1.75)	3.16	0.02	3.30 (1.74)	2.29 (1.48)	16.17***	0.11
Woman in Rain	U	2.74 (1.69)	2.79 (1.75)	0.17	0.00	3.11 (1.75)	2.23 (1.53)	11.75***	0.08
Tobacco Smoke Can Harm Your Children									
Smoke Approaching Baby	C	4.49 (2.12)	3.79 (2.16)	20.35***	0.13	4.65 (1.95)	3.28 (1.95)	15.72***	0.10
Smoke at Baby	C, A, U	4.35 (2.14)	3.79 (2.16)	15.25***	0.10	4.53 (2.02)	3.31 (2.02)	11.77***	0.08
Girl with Oxygen Mask	C, S, E	4.33 (2.14)	3.79 (2.16)	14.22***	0.09	4.50 (2.03)	3.32 (2.03)	12.24***	0.08
Smoke at Toddler	C	4.34 (2.00)	3.63 (2.00)	30.57***	0.18	4.38 (2.05)	3.36 (2.05)	10.88***	0.07
Girl Crying	C, S	4.17 (2.18)	3.63 (2.00)	12.89***	0.07	4.33 (2.00)	3.27 (2.00)	11.95***	0.08
Child Lettering	A	3.55 (2.07)	3.63 (2.00)	1.60	0.01	4.03 (2.02)	2.91 (2.02)	12.22***	0.08
Cigarettes Cause Fatal Lung Disease									
Healthy/Diseased Lungs	D	4.71 (1.98)	3.71 (2.01)	59.77***	0.30	4.50 (1.96)	3.78 (1.96)	5.46*	0.04
Toe Tag	S	4.38 (2.17)	3.63 (1.99)	43.02**	0.24	4.49 (2.01)	3.16 (2.01)	16.56***	0.11
Lungs Full of Cigarettes	M	4.05 (2.09)	3.63 (1.99)	10.37**	0.07	4.37 (1.99)	2.91 (1.99)	22.09***	0.14
Doctor with X-Ray	E	3.75 (2.01)	3.71 (2.01)	0.21	0.00	4.12 (1.99)	3.15 (1.99)	10.16**	0.07
Cigarettes Cause Cancer									
Deathly Ill Woman	S	5.06 (2.02)	3.83 (2.14)	66.01***	0.32	4.92 (1.93)	3.63 (1.93)	16.45***	0.11
Cancerous Lesion on Lip	D	4.75 (1.94)	3.66 (1.96)	60.55***	0.30	4.52 (1.95)	3.73 (1.95)	7.63**	0.05
Red Cigarette Burning	A	4.00 (2.05)	3.66 (1.96)	9.39**	0.06	4.19 (2.00)	3.29 (2.00)	8.56**	0.06
White Cigarette Burning	A	3.93 (2.15)	3.83 (2.14)	0.59	0.00	4.37 (2.05)	3.06 (2.05)	14.07***	0.09
Cigarettes Cause Stroke and Heart Disease									

				Label effect				Smoker status effect	
Label	**Image themes**	**Graphic label M (SD)**	**Text label M (SD)**	**F**	η_p^2	**Non-smokers M (SD)**	**Smokers M (SD)**	**F**	η_p^2
Oxygen Mask on Man's Face	S,E	4.44 (2.09)	3.64 (1.95)	28.17***	0.17	4.49 (1.94)	3.40 (1.97)	12.77**	0.08
Hand with Oxygen Mask	E	4.01 (2.07)	3.64 (2.06)	7.08**	0.05	4.30 (1.97)	3.05 (2.00)	14.82***	0.10
Man in Pain-Hand on Chest	S	3.94 (1.97)	3.64 (1.95)	7.12**	0.05	4.20 (1.94)	3.21 (1.87)	11.44***	0.08
Red Lightening with Heart	A	3.72 (2.13)	3.64 (2.06)	0.04	0.00	4.19 (2.03)	2.85 (1.96)	15.52***	0.10
Smoking During Pregnancy Can Harm Your Baby									
Baby in Incubator	C,A,S,E	4.32 (2.26)	3.81 (2.16)	14.17***	0.09	4.47 (2.10)	3.50 (2.24)	8.39**	0.06
Pacifier in Ashtray	M	4.19 (2.20)	4.01 (2.16)	0.40	0.00	4.65 (1.99)	3.17 (2.17)	18.10***	0.12
Smoking Can Kill You									
Man with Chest Staples	S,D	4.41 (1.99)	3.72 (2.10)	26.41***	0.16	4.61 (2.04)	3.16 (1.97)	18.52***	0.12
Red Coffin with Body	A	4.07 (2.27)	3.72 (2.10)	5.25*	0.04	4.47 (2.11)	2.92 (1.97)	20.73***	0.13
Man in Casket	S	3.95 (2.19)	3.61 (2.03)	6.62*	0.05	4.30 (2.09)	3.08 (1.98)	14.68***	0.10
Cigarettes=RIP	A	3.57 (2.07)	3.61 (2.03)	0.73	0.00	4.05 (2.04)	2.93 (1.92)	11.71***	0.08
Tobacco Smoke Causes Fatal Lung Disease in Non-smokers									
Graveyard	M	4.32 (2.17)	3.82 (2.18)	13.63***	0.09	4.78 (1.96)	2.91 (2.02)	32.43***	0.19
Man Smoke at Woman	U	4.26 (2.18)	3.82 (2.18)	11.16***	0.07	4.69 (1.99)	2.93 (2.06)	27.89***	0.17
Woman Crying	S	4.11 (2.09)	3.82 (2.18)	5.03*	0.03	4.66 (1.94)	2.82 (1.98)	31.19***	0.18
Woman Smoke at Man	U	3.96 (2.10)	3.85 (2.04)	0.41	0.00	4.60 (1.88)	2.92 (1.93)	33.67***	0.20
Man Hands Up And Smoke	U	3.94 (2.20)	3.85 (2.04)	0.22	0.00	4.62 (1.94)	2.76 (1.86)	39.55***	0.22
Quitting Now Greatly Reduces Serious Risk to Your Health									
Cigarettes in Toilet Bowl	M	2.56 (1.76)	2.71 (1.76)	2.75	0.02	3.06 (1.80)	2.00 (1.53)	13.58***	0.09
Man in 'I Quit' T-Shirt	M	2.17 (1.50)	2.56 (1.74)	15.19***	0.10	2.51 (1.70)	2.15 (1.48)	2.04	0.01
Woman Blowing Bubble	M	1.97 (1.34)	2.56 (1.74)	25.07***	0.15	2.36 (1.56)	2.12 (1.51)	1.15	0.01

Fear-related reactions scores ranged from 1 (not at all) to 7 (extremely). Image themes: A, art-graphics; C, child/baby; D, diseased body part; E, medical equipment; M, metaphor; S, suffering or dead person; U, unpleasant smoking experience. η_p^2=proportion of variance explained. The labels selected by the Food and Drug Administration in June 2011 appear in bold.

*p<0.05,

**p<0.01,

*** p<0.001.

Table 4

Feeling discouraged from wanting to smoke in response to graphic versus text warning labels for non-smokers (n=195) and smokers (n=113)

				Label effect				Smoker status effect	
Label	**Image themes**	**Graphic label M (SD)**	**Text label M (SD)**	**F**	η_p^2	**Non-smokers M (SD)**	**Smokers M (SD)**	**F**	η_p^2
Cigarettes are Addictive									
Hole in Throat	D	3.97 (1.26)	2.74 (1.36)	128.61***	0.48	3.84 (1.04)	2.52 (1.30)	61.01***	0.30
Cigarette Injection	M, A	3.22 (1.46)	2.74 (1.36)	21.91***	0.14	3.50 (1.22)	2.08 (1.26)	56.20***	0.28
Red Puppet	M, A	2.72 (1.38)	2.45 (1.30)	7.03**	0.05	3.06 (1.32)	1.86 (1.01)	46.39***	0.25
Woman in Rain	U	2.54 (1.34)	2.45 (1.30)	0.66	0.00	2.96 (1.31)	1.80 (0.98)	42.21***	0.23
Tobacco Smoke Can Harm Your Children									
Smoke Approaching Baby	C	3.86 (1.36)	3.31 (1.36)	23.58***	0.15	4.05 (1.04)	2.78 (1.47)	45.00***	0.25
Smoke at Baby	C, A, U	3.84 (1.32)	3.31 (1.36)	24.61***	0.15	4.02 (1.07)	2.81 (1.41)	42.20***	0.23
Girl with Oxygen Mask	C, S, E	3.64 (1.34)	3.31 (1.36)	10.36**	0.07	3.94 (1.07)	2.69 (1.41)	49.84***	0.26
Smoke at Toddler	C	3.64 (1.46)	3.13 (1.38)	34.23***	0.20	3.80 (1.26)	2.72 (1.40)	28.91***	0.17
Girl Crying	C, S	3.30 (1.48)	3.13 (1.38)	2.76	0.02	3.66 (1.30)	2.53 (1.34)	34.52***	0.20
Child Lettering	A	3.09 (1.52)	3.13 (1.38)	0.11	0.00	3.57 (1.34)	2.43 (1.35)	28.60***	0.17
Cigarettes Cause Fatal Lung Disease									
Healthy/Diseased Lungs	D	3.92 (1.20)	2.99 (1.27)	85.97***	0.39	3.81 (1.12)	2.88 (1.20)	28.58***	0.17
Toe Tag	S	3.70 (1.33)	3.23 (1.35)	27.68***	0.17	3.90 (1.11)	2.71 (1.37)	40.46***	0.23
Lungs Full of Cigarettes	M	3.45 (1.34)	3.23 (1.35)	5.13*	0.04	3.81 (1.14)	2.55 (1.29)	44.33***	0.24
Doctor with X-Ray	E	3.07 (1.31)	2.99 (1.27)	1.13	0.01	3.46 (1.23)	2.38 (1.11)	35.84***	0.21
Cigarettes Cause Cancer									
Deathly Ill Woman	S	4.29 (1.06)	3.30 (1.41)	97.21***	0.41	4.16 (0.97)	3.16 (1.38)	35.34***	0.20
Cancerous Lesion on Lip	D	4.11 (1.13)	3.04 (1.39)	89.46***	0.39	4.00 (1.13)	2.93 (1.17)	45.45***	0.25
White Cigarette Burning	A	3.48 (1.44)	3.30 (1.41)	3.17	0.02	3.85 (1.18)	2.59 (1.46)	37.26***	0.22
Red Cigarette Burning	A	3.33 (1.33)	3.04 (1.39)	9.99**	0.07	3.62 (1.31)	2.53 (1.16)	34.38***	0.20
Cigarettes Cause Strokes and Heart Disease									

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				Label effect				Smoker status effect	
Label	**Image themes**	**Graphic label M (SD)**	**Text label M (SD)**	**F**	η_p^2	**Non-smokers M (SD)**	**Smokers M (SD)**	**F**	η_p^2
Oxygen Mask on Man's Face	S,E	3.63 (1.34)	3.03 (1.32)	35.04***	0.20	3.80 (1.17)	2.64 (1.24)	42.05***	0.23
Hand with Oxygen Mask	E	3.35 (1.38)	3.22 (1.37)	2.49	0.02	3.75 (1.15)	2.49 (1.35)	41.35***	0.23
Man in Pain-Hand on Chest	S	3.25 (1.34)	3.03 (1.32)	8.26**	0.06	3.60 (1.24)	2.48 (1.15)	38.10***	0.22
Red Lightening with Heart	A	3.15 (1.38)	3.22 (1.37)	0.61	0.00	3.67 (1.16)	2.39 (1.32)	38.69***	0.22
Smoking During Pregnancy Can Harm Your Baby									
Baby in Incubator	C,A,S,E	3.54 (1.51)	3.21 (1.48)	12.20***	0.08	3.74 (1.36)	2.79 (1.52)	17.69***	0.11
Pacifier in Ashtray	M	3.68 (1.42)	3.46 (1.36)	3.52	0.02	4.09 (1.04)	2.67 (1.46)	51.78***	0.27
Smoking Can Kill You									
Man with Chest Staples	S,D	3.81 (1.36)	3.32 (1.43)	27.40***	0.17	4.07 (1.14)	2.69 (1.39)	52.67***	0.28
Red Coffin with Body	A	3.47 (1.43)	3.32 (1.43)	2.38	0.02	3.94 (1.16)	2.45 (1.36)	55.26***	0.29
Man in Casket	S	3.33 (1.46)	2.98 (1.41)	16.08***	0.11	3.68 (1.35)	2.45 (1.24)	36.42***	0.21
Cigarettes=RIP	A	3.05 (1.42)	2.98 (1.41)	0.14	0.00	3.61 (1.33)	2.17 (1.10)	53.03***	0.28
Tobacco Smoke Causes Fatal Lung Disease in Non-smokers									
Graveyard	M	3.55 (1.41)	3.15 (1.50)	12.53***	0.08	3.89 (1.20)	2.46 (1.42)	51.74***	0.27
Man Smoke at Woman	U	3.52 (1.38)	3.15 (1.50)	16.24***	0.10	3.87 (1.16)	2.43 (1.44)	47.99***	0.26
Woman Crying	S	3.44 (1.39)	3.15 (1.50)	8.63**	0.06	3.85 (1.17)	2.36 (1.41)	53.57***	0.28
Woman Smoke at Man	U	3.03 (1.43)	2.95 (1.40)	0.39	0.00	3.55 (1.36)	2.20 (1.08)	48.60***	0.26
Man Hands Up And Smoke	U	3.02 (1.47)	2.95 (1.40)	0.06	0.00	3.57 (1.32)	2.14 (1.12)	58.47***	0.30
Quitting Smoking Now Greatly Reduces Serious Risk to Health									
Cigarettes in Toilet Bowl	M	2.69 (1.40)	2.71 (1.39)	0.21	0.00	3.13 (1.36)	2.03 (1.20)	25.72***	0.16
Man in 'I Quit' T-Shirt	M	2.47 (1.30)	2.51 (1.26)	0.31	0.00	2.83 (1.32)	1.98 (1.01)	21.26***	0.13
Woman Blowing Bubble	M	2.13 (1.24)	2.51 (1.26)	15.03***	0.10	2.63 (1.34)	1.84 (0.92)	20.59***	0.13

Response scale ranged from 1 (not at all) to 5 (very much). Image themes: A, art-graphics; C, child/baby; D, diseased body part; E, medical equipment; M, metaphor; S, suffering or dead person; U, unpleasant smoking experience. η_p^2=proportion of variance explained. The labels selected by the Food and Drug Administration in June 2011 appear in bold.

*p<0.05,

**p<0.01,

*** p<0.001.