

Which Images and Features in Graphic Cigarette Warnings Predict Their Perceived Effectiveness? Findings from an Online Survey of Residents in the UK

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Abstract

Background Many countries are implementing graphic warnings for cigarettes. Which graphic features influence their effectiveness remains unclear.

Purpose To identify features of graphic warnings predicting their perceived effectiveness in discouraging smoking.

Method Guided by the Common-Sense Model of responses to health threats, we content-analyzed 42 graphic warnings for attributes of illness risk representations and media features (e.g., photographs, metaphors). Using data from 15,536 survey participants, we conducted stratified logistic regressions testing which attributes predict participant selections of warnings as effective.

Results Images of diseased body parts predicted greater perceived effectiveness; OR=6.53–12.45 across smoking status (smoker, ex-smoker, young non-smoker) groups. Features increasing perceived effectiveness included images of dead or sick persons, children, and medical technology; focus on cancer; and photographs. Attributes decreasing perceived effectiveness included infertility/impotence, addictiveness, cigarette chemicals, cosmetic appearance, quitting self-efficacy, and metaphors.

Conclusions These findings on representational and media attributes predicting perceived effectiveness can inform strategies for generating graphic warnings.

Keywords Tobacco control · Graphic warning labels · Common-sense model · Illness risk representations · Health communications · Imagery

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Tobacco use remains the single most preventable cause of mortality worldwide [1]. In many countries, tobacco prevention and control efforts include policies requiring the use of warnings on tobacco products to inform citizens of the health risks. The World Health Organization's Framework Convention on Tobacco Control calls for the implementation of large warning labels, preferably with graphic images relating to the harms of smoking and benefits of quitting [2, 3]. Graphic warnings are now used in over 60 countries including Canada, Australia, the UK, Mexico, and New Zealand [4]. With the passage of the Family Smoking Prevention and Tobacco Control Act in 2009, the USA now has a mandate to implement new warnings for cigarette packs and to develop systematic processes for generating and evaluating these warnings over the coming years.

Although growing evidence suggests that graphic warnings can increase motivations to not smoke and attempts to quit [5–9], their use is not without controversy [10, 11]. The tobacco industry and other opponents typically argue that they are ineffective and unnecessary and that the more disturbing images demonize smokers [12–14]. Moreover, some experimental research suggests that some graphic images in warnings can induce defensive denial about personal risk [15, 16]. Recently, the US courts ruled against the implementation of a set of graphic warnings proposed by the Food and Drug Administration on the grounds that they violated the tobacco companies' right to free speech and the lack of evidence that the warnings increase knowledge about the potential consequences of smoking cigarettes [17]. The impact of graphic warnings on the appreciation of health consequences of smoking and decisions to smoke thus remains an empirical issue with important implications for tobacco control policies.

The impact of graphic warnings on smoking motivations and behavior is likely to vary not only by sociodemographic and cultural factors [18] but also by the nature and content of the images themselves: Whereas some might be persuasive,

others might be ineffective or have counterproductive effects. Further, graphic warnings might lose their impact on smoking motivations and behavior over time as individuals become habituated and desensitized to them. There is a critical need for further research to identify which types of graphic warnings most effectively discourage smoking, and the potential for habituation to warnings highlights the need for an ongoing system for developing new graphic warnings into the future.

A theory-guided approach to designing graphic warnings can serve to enhance the efficiency and effectiveness of the process of developing and implementing new warnings over time. The Common-Sense Model (CSM [19, 20]), which delineates the cognitive and affective processes guiding responses to health risk information, provides a useful theoretical framework for this process. Of particular relevance is the model's delineation of the role of health threat representations (schema or mental structures) in organizing and storing relevant information. These representations are structured to promote the search for and encoding of information about specific attributes. These attributes include *identity*, of which three components can be depicted in warning labels: symptoms or diseased body parts such as mouth lesions or gangrenous limbs; disease labels such as cancer or heart disease; and prototypical individuals with the condition, such as people who are ill or babies as victims of smoking-related birth defects. Other representational attributes include *timeline* (e.g., at what point in one's lifetime does the health condition occur, such as in young versus late adulthood), *consequences* (e.g., death, skin damage, pain), *cause* (e.g., chemicals in cigarettes cause lung cancer, nicotine causes addiction), and *control* (e.g., self-efficacy—ability to quit smoking, and treatment efficacy—health professionals can provide treatments that enable one to quit smoking). According to CSM theory and research, these representations activate emotional reactions (e.g., fear or worry) and guide protective behaviors (e.g., curbing or quitting smoking). Studies in other health domains demonstrate that communications targeting CSM representational attributes can increase recovery behaviors such as return to work and cardiac rehabilitation attendance following myocardial infarction [21, 22]; promote patient adherence to medical treatment [23]; and increase heart disease worry, protective intentions, and protective behavior of at-risk adults [24].

The CSM provides a useful framework for developing and evaluating the effects of graphic warning labels for several reasons. First, the proposed structure and contents of representations point to key features of graphic warnings likely to motivate people to not smoke. Individuals should be predisposed to attend to, process, and store warning information relating to the five attributes of identity, cause, consequences, timeline, and control. Second, the CSM identifies the parallel roles of abstract-conceptual processes, which involve information with a linguistic structure, and concrete-experiential processes, which involve information in the form

of visual images and other perceptual experiences. Cognition and neuroscience research demonstrates that, relative to information presented in the form of words or text, image-based information is processed more rapidly, evokes stronger emotional responses, induces greater cognitive processing and attitude development, and is more easily recalled [25]. Individuals are thus likely to perceive graphic warnings as more persuasive compared to text-only warnings conveying the same information. Third, the CSM identifies the interactive dynamics of problem-focused regulation processes and processes involving the arousal and regulation of emotions such as fear, worry, and disgust [19]. Fear and worry arousal represent critical components of the protection motivation process, and meta-analyses confirm the persuasiveness of fear appeals [26]. Graphic warnings, by their emotionally evocative design, can activate both problem solving and emotion regulation systems involved in the protection motivation process [27]. In addition to their informational impact, they might directly discourage smoking through their elicitation of fear-related emotions [6] and disgust [28].

Research guided by the CSM indicates that images relating to symptoms or signs of disease may be particularly impactful in motivating efforts to protect one's health [20, 25]. For example, individuals who associate mental images of skin lesions (e.g., blackened skin, large moles) with their representations of skin cancer risk and who report moderate to high worry about skin cancer are more likely than individuals with no mental images of skin lesions to be motivated to engage in sun protection and skin self-examinations [20]. Graphic warnings depicting diseased body parts such as tumors, blackened lungs, and lesions could therefore be particularly effective in promoting worry, disgust, and motivations to not smoke [6, 29].

The aim of the present study was to identify features or attributes of warning label images that might be most effective in discouraging individuals from smoking. The graphic warnings used in this study were developed in response to the European Commission's (EC) Tobacco Products Directive [30], which provided new rules on the use of graphic images on tobacco packaging in order to reinforce the written health warnings already used for these products. Three graphic warnings were developed for each of the 14 EC-approved written health warnings, resulting in 42 graphic images authorized to appear on cigarette packaging. We used data on perceived effectiveness of these warnings gathered through a large community survey conducted by the Department of Health of England and Wales in 2006 as part of a public consultation exercise for selecting which of these graphic warnings should be used in the UK [31]. Over 19,000 consumers responded to a web-based survey in which they evaluated the 42 warnings in terms of their effectiveness in encouraging smokers to quit. Based on the survey responses, 15 warnings were selected for use on all cigarette packs sold in the UK beginning in 2008.

The UK Department of Health kindly provided the survey data for further evaluation of consumer responses to graphic warning labels.

We conducted content analyses of the 42 graphic warnings using categories reflecting risk representational attributes identified by the CSM. For example, content categories relating to identity included (1) diseased body parts; (2) victim imagery such as people who are sick or dead or who are children or babies; and (3) disease labels such as “cancer” and “heart disease” specified in the warning statement. Additional content categories included factors relating to specific media features: use of photographs (rather than drawings), medical technology images (e.g., an X-ray, microscopic image of sperm, or medical image of a fetus), or artistic metaphors (e.g., a wrinkled apple to depict premature aging of skin caused by smoking).

We hypothesized that warning features reflecting the CSM representational attributes of identity, cause, consequences, timeline, and control would predict perceived warning effectiveness, and the identity attribute of diseased body parts would be the strongest positive predictor of perceived effectiveness in discouraging smoking. Of the media feature categories, we hypothesized that use of photographs and medical technology images would predict higher perceived effectiveness because they are highly realistic and salient images. In contrast, we predicted that use of metaphorical images, given that their potential artistic appeal might elicit positive reactions, would predict lower perceived effectiveness in discouraging smoking.

We also explored whether patterns of attributes predicting perceived effectiveness vary across smoking status groups (i.e., smokers, ex-smokers, and young non-smokers), gender, and ethnicity groups. These exploratory analyses were conducted to identify ways in which attributes might be differentially effective across these social groups and thus potentially inform strategies for tailoring warnings to include specific attributes as a means of targeting specific groups.

Method

Design and Procedure

The study utilized data from a national reference, web-based, public consultation exercise involving evaluations of graphic warning labels and content analysis of these warning labels. The UK Department of Health granted permission to access the anonymous responses from the national public consultation survey.

In total, 19,812 UK residents responded to the anonymous, web-based survey. These respondents identified their age groups as either 16–34 (52.6 %), 35–49 (32.9 %), or 50 and older (14.5 %). Overall, 22.7 % ($n=4501$) were smokers,

26.8 % ($n=5303$) were ex-smokers, and 50.5 % ($n=10,008$) of the respondents were non-smokers. Of the non-smokers, we included only those in the 16–34 age group ($n=5732$) since non-smokers over the age of 34 have a low risk of smoking initiation [32]. Among smokers, 59.0 % were ages 16–34, 28.4 % were ages 35–49, and 12.6 % were ages 50 and older. Among ex-smokers, 38.5 % were ages 16–34, 39.7 % were ages 35–49, and 21.8 % were ages 50 and older. The final sample ($n=15,536$) was 50.7 % male and predominantly White (88.8 %; Asian, 3.7 %; Black, 1.6 %; other, 5.9 %).

The 42 warnings included in this survey were developed by the European Commission and can be viewed on their UK Combined Warnings website [33]. Each of the 42 warnings includes a warning statement, such as “Smokers die younger” or “Smoking when pregnant harms your baby,” selected from 14 text warnings mandated under EU legislation. Of the 42 warnings, 36 include a graphic image (photograph, drawing, or medical technology image such as an X-ray) and 6 depict the warning statement in large red and white letters on a black background with no pictorial image.

The UK Department of Health designed the survey and launched a national media campaign May–August 2006, with news stories and announcements delivered via television, radio, print media, and the internet describing the survey and inviting all resident of the UK to visit the website (packwarnings.nhs.uk) and participate [31]. Upon logging on to the consultation website, participants were asked to review all 42 warning labels presented in a random order. Smokers were instructed to identify all of the warnings that might make them wish they did not smoke or make them want to try and give up. Non-smokers were instructed to identify all of the warnings that they thought might help persuade smokers to think about giving up. The online survey thus provided a dataset indicating the number of selections or “votes” for each warning.

In a separate process, we conducted content analyses to assign theoretically based codes to each of the warnings. The authors collaborated in the development of the coding categories and process, using CSM theory and research on illness representations [34] and media semiotics [35] to generate a list of representational attributes and media features. They then reviewed graphic warnings from several countries [36] to add specific categories (e.g., cancer and heart disease) within the attribute domains (e.g., identity: label). The authors then trialed the coding process by independently coding a test set of graphic warnings and then conferring to identify and resolve discrepancies in interpretations. The authors then independently coded the 42 graphic warnings using the final set of 19 categories listed in Table 1. Each label received a rating of 1 (*contains the attribute*) or 0 (*does not contain the attribute*) for each of the categories; each label could be coded as having multiple attributes. Inter-rater agreement ranged from 90 to 100 %; Cohen’s kappa range: .74–1.00. All discrepancies were resolved through consultation with a third rater.

Table 1 Warning attribute categories and examples of images and statements (in quotations)

Attribute	Examples	Number (%) warnings with attribute
Identity: diseased/damaged body part	Diseased lung; damaged teeth	3 (7.1 %)
Identity: label		
Cancer	“Smoking causes fatal lung cancer”; neck tumor	4 (9.5 %)
Heart disease	“Smoking...causes heart attacks and strokes”; heart surgery	6 (14.3 %)
Identity: image of a person		
Child or baby as victim	Child with oxygen mask; baby in hospital crib	6 (14.3 %)
Dead or sick person	Corpse in morgue; man in hospital bed with feeding tubes, eyes closed	9 (21.4 %)
Causal mechanisms for harm		
Affects blood flow	“Smoking clogs the arteries...”, ultrasound showing blocked vessel	3 (7.1 %)
Addictive	“Smoking is highly addictive...”; man with IV and in wheelchair, smoking	4 (9.5 %)
Contains chemicals	“Smoke contains benzyne, nitrosamines,...[and other chemicals]”	2 (4.8 %)
Consequences		
Pain/suffering	Man in agony clutching prison bars of cigarettes; “slow & painful death”	10 (23.8 %)
Aversive medical treatment	Heart surgery; man in hospital bed with oxygen mask and tubes	8 (18.6 %)
Infertility/impotence	Damaged sperm; limp cigarette; woman with empty stroller	6 (14.3 %)
Cosmetic appearance	Premature aging; wrinkled skin	3 (7.1 %)
Death	“Smokers die younger”; toe tag on foot	12 (28.6 %)
Timeline: age of effects		
Adolescence/young adult (versus older adulthood)	Young couple in bed dealing with impotence; young woman’s face with premature aging of skin	19 (44.2 %)
Control in quitting		
Self-efficacy	“You can do it [quit]”; figure throwing cigarettes in trashcan	6 (14.3 %)
Treatment efficacy	“Your doctor can help you quit”; helping hand	8 (19.0 %)
Media features		
Photograph	Photograph as opposed to drawing or text-only message	27 (64.2 %)
Medical technology image	X-ray; microscopic image of sperm; ultrasound photo of fetus	3 (7.1 %)
Metaphor	Cigarette in hypodermic needle; man walking in tunnel towards light	8 (19.0 %)

Statistical Analyses

For descriptive purposes, we calculated overall warning selection rates and conducted χ^2 analyses to test for differences in overall warning selection rates across the smoking status groups. To test whether each of the label attributes predicted warning label selection by survey respondents, we used SAS software Version 9.2 [37] to conduct stratified, conditional, logistic regressions with warning label selection (*yes* or *no*) as the dependent variable, warning label as the classification variable, participant as the strata variable, and the warning label attributes listed in Table 1 as the independent variables. Separate analyses were conducted for smokers, ex-smokers, and young non-smokers (ages 16–34).

Additional, exploratory analyses were conducted to test whether the patterns of attributes predicting perceived effectiveness vary according to smoking status, gender, and ethnicity. To directly test for smoking status group differences, we conducted a stratified, conditional, logistic regression analysis with all participants testing the main and interaction effects of

smoking status group (coded as dummy variables) and each of the label attributes in Table 1 on warning label selection. To test for gender differences, we conducted three sets of stratified, conditional, logistic regression analyses that included: (1) men and women smokers; (2) men and women ex-smokers; and (3) young men and women non-smokers. These models included the main and interaction effects of gender and each of the label attributes in Table 1 as predictors of warning label selection. We conducted similar sets of analyses testing the main and interactive effects of ethnicity and attributes on label selection: (1) comparing White and Asian participants; (2) comparing White and Black participants; and (3) comparing White participants and those identifying with all other ethnicities.

Because of the large sample size and multiple analyses, the significance level was set at $p < .001$ for all analyses to reduce Type I error rates. This significance level corresponds to a minimum 10 % difference in odds of selection between attribute presence versus absence, i.e., a 10 % greater chance (OR ≥ 1.10) of selection or a 10 % lower chance (OR ≤ 0.91 which is equal to $1/1.10$) or less of selection.

Results

The proportions of participants selecting a specific warning as effective ranged from 6.4 % (for warning 14, depicting a drawing of a person throwing a cigarette pack in a trashcan and the statement, “Stopping smoking reduces the risk of fatal heart and lung diseases”) to 80.4 % (for warning 17, with a photograph of a large neck tumor and the statement, “Smoking can cause a slow and painful death”); $M=29.8$ %. For 34 (81 %) of the 42 labels, selection rates were lower for smokers than for non-smokers or ex-smokers; all $\chi^2(2, n=15,536) > 15.00, ps < .001$.

Table 2 presents the odds ratios and confidence intervals for warning label attributes as predictors of label selection (indicating perceived effectiveness of the label in discouraging smoking) from the stratified, conditional logistic regression analyses for each smoker status group. Superscripts indicate significant differences in odds ratios for an attribute within a smoker status group, as identified through the analyses testing for attribute X smoking status group interaction effects. Figure 1 illustrates those attributes that significantly increased and decreased the odds of label selection for the three smoker status groups.

As predicted, diseased body parts (an identity representational attribute) emerged as the strongest predictor of a warning label being selected as effective in discouraging people from smoking. For smokers, the odds of selecting a label

depicting a diseased body part were more than six times the odds of selecting a label without that depiction. For ex-smokers, the odds of selecting a label depicting a diseased body part were more than seven times the odds of selecting a label without that depiction. For young non-smokers, the odds of selecting a label showing a diseased body part was over 12 times the odds of selecting a label without this attribute.

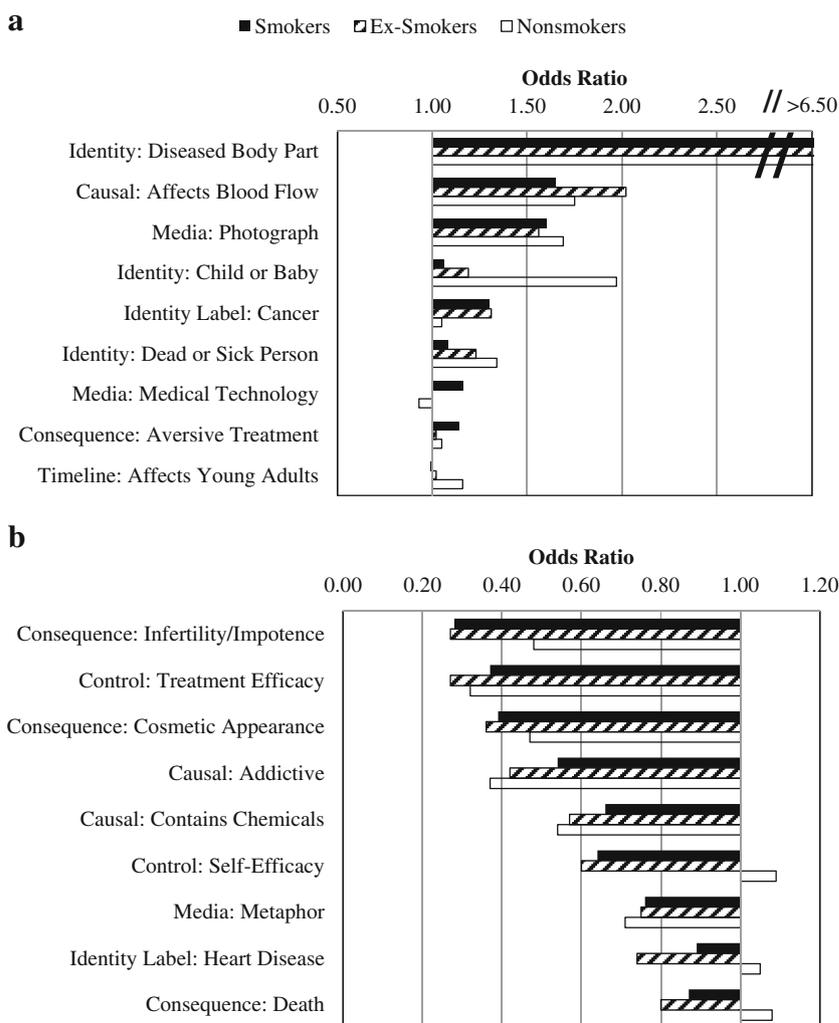
Other attributes also increased the odds of warning label selection, although the odds ratios were markedly lower than those observed for diseased body parts. Focus on the causal mechanism of smoking affects blood flow, and use of a photograph (media feature) increased the odds of warning label selection for all smoking status groups. Focus on cancer (identity) increased the odds of selection for smokers and ex-smokers, whereas depictions of aversive medical treatments (consequences) and medical technology (media feature) did so for smokers only. The image of a dead or sick person increased the odds of selection for ex-smokers and young non-smokers, and depictions of pain or suffering did so for ex-smokers (although they decreased the odds of selection for young non-smokers). Depictions of harms that occur in young adulthood increased the odds of selection for young non-smokers. Six of the warning attributes decreased the odds of a warning being selected as effective for all smoking status groups: addictiveness (causal mechanism), cigarettes contain chemicals (causal mechanism), infertility or impotence (consequences), cosmetic appearance (consequences), treatment

Table 2 Stratified, conditional, logistic regression analyses of warning attributes as predictors of selection of graphic warnings as effective in discouraging smoking

Warning label attribute	Smokers (<i>n</i> =4501) OR (CI)	Ex-smokers (<i>n</i> =5303) OR (CI)	Young non-smokers (<i>n</i> =5732) OR (CI)
Identity: diseased body part	6.53^a (6.04–7.06)	7.83 (7.29–8.40)	12.45^b (11.60–13.36)
Identity: cancer	1.30^a (1.22–1.39)	1.31 (1.24–1.39)	1.05 ^b (1.00–1.10)
Identity: heart disease	0.89 (0.80–0.98)	0.74 (0.68–0.81)	1.05 (0.97–1.10)
Identity: child or baby	1.06 ^a (0.95–1.18)	1.19 (1.08–1.31)	1.97^b (1.80–2.16)
Identity: dead or sick person	1.08 ^a (1.00–1.16)	1.23 (1.15–1.31)	1.34^b (1.26–1.43)
Causal mechanism: affects blood flow	1.65^a (1.53–1.78)	2.02^b (1.89–2.15)	1.75 (1.66–1.85)
Causal mechanism: addictive	0.54^a (0.49–0.60)	0.42 (0.38–0.45)	0.37^b (0.34–0.41)
Causal mechanism: contains chemicals	0.66^a (0.60–0.73)	0.57 (0.52–0.63)	0.54^b (0.49–0.59)
Consequence: pain/suffering	1.06 ^a (1.00–1.11)	1.07 (1.03–1.11)	0.93^b (0.90–0.97)
Consequence: aversive treatment	1.14 (1.07–1.21)	1.02 (0.97–1.07)	1.05 (1.00–1.10)
Consequence: infertility/impotence	0.28^a (0.26–31)	0.27 (0.25–0.29)	0.48^b (0.44–0.52)
Consequence: cosmetic appearance	0.39 (0.35–0.44)	0.36 (0.33–0.40)	0.47 (0.43–0.52)
Consequence: death	0.87 (0.78–0.97)	0.80 (0.73–0.88)	1.08 (0.99–1.18)
Timeline: affects young adults	0.99 ^a (0.93–1.06)	0.95 (0.90–1.01)	1.16^b (1.10–1.23)
Control: self-efficacy	0.64^a (0.53–0.77)	0.60 (0.51–0.71)	1.09 ^b (0.92–1.28)
Control: treatment efficacy	0.37 (0.32–0.43)	0.27 (0.24–0.31)	0.32 (0.28–0.37)
Media feature: photograph	1.60 (1.49–1.72)	1.56 (1.47–1.66)	1.69 (1.59–1.80)
Media feature: medical technology	1.16^a (1.09–1.23)	1.00 (0.95–1.06)	0.93 ^b (0.88–0.97)
Media feature: metaphor	0.76 (0.72–0.81)	0.75 (0.72–0.79)	0.71 (0.68–0.74)

All significant label attribute main effects appear in bold, $p < .001$. Superscripts indicate significant differences between smokers and either ex-smokers or young non-smokers in the strength of the relationship between the attribute and label selection; $p < .001$

Fig. 1 Attributes predicting the odds of the selection of graphic warnings as effective in discouraging smoking for smokers, ex-smokers, and young non-smokers (ages 16–34). **a** Attributes increasing the odds of graphic warning selection. **b** Attributes decreasing the odds of graphic warning selection



efficacy (control), and use of metaphor (media feature). Messages focusing on heart disease (identity), death (consequences), and self-efficacy (control) reduced the odds of warning selection for both smokers and ex-smokers, but they did not affect the odds of selection for young non-smokers.

Analyses of smoking status group differences in the patterns of attributes predicting warning selection revealed that the odds of selection were lower for smokers than for young non-smokers on seven attributes (see Table 2). The odds were lower for smokers than for young non-smokers for warnings focusing on diseased body parts, child or baby, sick or dead person, addictiveness, cigarettes contain chemicals, infertility/impotence, consequences affecting young adults, and self-efficacy. The odds of warning selection were greater for smokers than for young non-smokers for only three attributes: cancer, pain and suffering, and medical technology. Smokers and ex-smokers were generally comparable in the strength of attributes predicting warning selection, with the exception that the causal mechanism attribute of smoking

affects blood flow was a stronger predictor of warning selection for ex-smokers than for smokers.

Further analyses explored gender and ethnic differences in the direction or strength with which attributes predicted warning selection. Table 3 presents the odds ratios of attributes for which significant gender X attribute interaction effects emerged. For diseased body parts, the increase in odds of selection was greater for female smokers than for male smokers. Focus on heart disease reduced the odds of selection more for female than for male ex-smokers and non-smokers. Depictions of a child or baby increased the odds of selection for women in all groups, whereas they reduced the odds of selection for male smokers, had no effect for male ex-smokers, and had a weaker, positive effect for young male non-smokers. Depictions of a dead or sick person increased the odds of selection for female smokers and ex-smokers but not for their male counterparts. Messages that smoking affects blood flow increased the odds of selection more for men than for women in all three smoking status groups. Warnings depicting pain and suffering increased the odds of selection

Table 3 Odds ratios for attributes for which gender moderates their prediction of selection of graphic warnings as effective in discouraging smoking

Warning label attribute	Smokers		Ex-smokers		Young non-smokers	
	Males (<i>n</i> =2456) OR (CI)	Females (<i>n</i> =2045) OR (CI)	Males (<i>n</i> =2487) OR (CI)	Females (<i>n</i> =2816) OR (CI)	Males (<i>n</i> =2935) OR (CI)	Females (<i>n</i> =2797) OR (CI)
Identity: diseased body part	5.86^a (5.28–6.50)	7.56^b (6.74–8.48)				
Identity: heart disease			0.94 ^a (0.87–1.03)	0.74^b (0.68–0.86)	1.03 ^a (0.95–1.12)	0.86^b (0.79–0.93)
Identity: child or baby	0.83^a (0.75–0.92)	1.55^b (1.39–1.74)	0.95 ^a (0.86–1.05)	1.71^b (1.56–1.86)	1.35^a (1.23–1.48)	2.27^b (2.08–2.49)
Identity: dead or sick person	0.96 ^a (0.87–1.06)	1.24^b (1.12–1.37)	1.07 ^a (0.97–1.18)	1.38^b (1.27–1.50)		
Causal mechanism: affects blood flow	2.03^a (1.84–2.24)	1.22^b (1.08–1.38)	2.60^a (2.36–2.87)	1.67^b (1.54–1.82)	2.03^a (1.87–2.20)	1.50^b (1.39–1.62)
Consequence: pain/suffering	0.99 ^a (0.94–1.05)	1.17^b (1.10–1.25)				
Consequence: aversive treatment	1.28^a (1.19–1.39)	1.00 ^b (0.92–1.09)	1.16^a (1.07–1.25)	0.94 ^b (0.87–1.00)		
Consequence: infertility/impotence	0.34^a (0.30–0.39)	0.25^b (0.22–0.29)	0.25^a (0.22–0.27)	0.32^b (0.29–0.36)	0.40^a (0.36–0.44)	0.49^b (0.46–0.55)
Consequence: death	1.03 ^a (0.93–1.14)	0.82^b (0.73–0.91)				
Media feature: medical technology			1.22^a (1.13–1.33)	0.84^b (0.78–0.90)	1.08 ^a (1.00–1.16)	0.81^b (0.75–0.87)

All significant label attribute main effects appear in bold, $p < .001$. Superscripts indicate significant gender differences in the strength of the relationship between the attribute and label selection; $ps < .001$

whereas depictions of death decreased the odds of selection for female smokers but not for male smokers. For infertility or impotence, the reductions in odds ratios were greater for female smokers than for male smokers; for male ex-smokers than for female ex-smokers; and for male non-smokers than for female non-smokers. Finally, depictions of medical technology reduced the odds of selection for female ex-smokers and young non-smokers but not for their male counterparts. Analyses testing ethnic group differences in patterns of attributes predicting label selection revealed no differences between White participants and either Asian participants, Black participants, or participants reporting other ethnic identities.

Discussion

The present study provides new information regarding the associations of specific attributes of graphic warnings with their perceived effectiveness in discouraging smoking. This knowledge can contribute to the development of systems for generating warnings most likely to have the intended effects of motivating individuals to not smoke. In addition to the importance of perceived effectiveness as a likely precursor to behavior change, this outcome measure is also of public health importance because of its continuing use as a key criterion in the selection of graphic warnings in countries such as the USA [38] and the UK, as exemplified by the warning selection process that produced the data in the present study. The findings also contribute to scientific theory regarding how individuals process and respond to image-based communications about

health risks [25, 39]. They support the utility of the CSM for identifying how images and messages reflecting specific risk-representational attributes influence responses to warnings.

Images of diseased or damaged body parts (symptoms), an identity attribute of illness risk representations, emerged as the strongest predictor of perceived warning effectiveness. The odds of selecting warnings with images such as a neck tumor, damaged teeth, and diseased lungs were over 6 to 12 times the odds of selecting warnings that did not depict diseased body parts. These findings converge with other evidence supporting the powerful impact of depictions of diseased organs and other body parts in cigarette warnings [6, 40]. To our knowledge, this study is the first to estimate the independent impact of this type of image while controlling for multiple features of graphic warning contents. The large impact of these images reflecting bodily disease also converges with evidence that mental images of bodily symptoms are important motivators of protective behavior [20] just as physical symptom experiences strongly drive protective behavior [19, 41]. The predictive effects of this attribute were more muted for smokers, and particularly for male smokers, than for ex-smokers and non-smokers. Other studies have also found that these graphic warnings elicit weaker reactions from smokers than from non-smokers [6, 38]. Possibilities for these muted effects include: (1) greater familiarity with or habituation to images such as damaged teeth; and (2) defensive responses such as rationalization elicited by their vulnerability to these harms [15, 42]. Further research can test whether these factors mediate the relationship between smoking status and perceived effectiveness. Nevertheless, the large odds ratio (6.53) supports their potential effectiveness for regular smokers.

Other features reflecting identity attributes predicted greater perceived effectiveness of warnings in discouraging smoking. Warnings specifying the illness label of cancer increased the odds of warning selection for smokers and ex-smokers, a finding consistent with common construals of cancer as a particularly feared disease [43]. Depictions of victims of smoking—i.e., sick or dead people, children, or babies—increased the odds of warning selection particularly for women, with the exception that both men and women non-smokers were equally responsive to depictions of dead or sick people. Anti-smoking campaigns are increasingly focusing on personal stories of people suffering health consequences of smoking [44]. The CSM, along with other theories of health communication and persuasion [45, 46], emphasizes the importance of identifying with characters experiencing the harms for viewing the risk as self-relevant, which, in turn, enhances protection motivations. Yet, evidence is mixed on the effects of “testimonial” information from victims in cigarette warnings; some findings suggest that they increase effectiveness [9] whereas others suggest that testimonial messages are less impactful than didactic messages [47]. Further research delineating the dynamics of responses to messages about individuals suffering harms of smoking is warranted.

Other risk representational attributes predicted greater perceived effectiveness of warnings, although these associations varied across the smoking status and gender groups. These attributes included causal information about smoking affecting blood flow (more strongly for men than for women), consequence information about pain and suffering (for ex-smokers and women smokers), and experiences involving aversive medication treatments (for male smokers and ex-smokers), and timeline information that the harms occur at a young age (for young non-smokers). The variation in patterns of associations suggest that the warnings are unlikely to be uniformly effective for all populations and they can inform further research testing the potential utility of tailoring warnings to address specific populations.

These and other findings that graphic warnings with disturbing images may be perceived as effective in discouraging smoking may appear to conflict with evidence that individuals attempt to avoid them. In countries where graphic warnings have been introduced, both interviews with shopkeepers [48] and anecdotal reports from smokers suggest that some consumers actively avoid purchasing packs with disturbing label images (e.g., blackened lungs) and request packs with less disturbing label images (e.g., a pregnant woman). Yet, these acts suggest that consumers have created mental images of the warning labels that are accessed at point of purchase. Given the potential for graphic images to instill intrusive images into the minds of smokers [3, 29], even brief exposures to graphic warnings are likely to create mental images that are elicited in response to smoking cues. These mental images might trigger aversive responses to smoking which,

over time, may contribute to motivations to stop smoking or avoid initiation. Findings from studies with smokers following the introduction of warning labels provide support that, although graphic warnings may induce avoidance attempts for some smokers, they nevertheless promote thoughts of quitting and attempts to quit. Adolescents who smoked reported increased thoughts about quitting after the introduction of graphic warnings [49], and adults who reported attempts to avoid the new warnings were just as likely as adults who did not to think about the warnings and engage in quit behavior 3 months later [8]. Moreover, recent evidence indicates that avoidance reactions stimulated by graphic warnings predicted increased thoughts of the harms of smoking which, in turn, promoted worry, quit intentions, and quit attempts [50]. Future research that closely examines the role of mental images created by exposure to graphic warnings could further contribute to understanding the relationships between attentional avoidance efforts induced by graphic warnings and their impact on quit motivations and behavior over the longer term.

Other risk representational features reduced the perceived effectiveness of the warnings. Across all groups, information about the consequences of infertility/impotence and cosmetic appearance as well as causal information about cigarettes being addictive and containing dangerous chemicals reduced the odds of a warning being selected as effective in discouraging smoking. These topics appear to be perceived as of lesser importance to consumers in general. Of particular note is the apparent lack of impact of messages about addiction for young non-smokers, for whom this information is arguably of greatest relevance. Other studies have also found that non-smokers appear to be fairly immune to messages about the addictiveness of cigarettes [6, 51], and it is likely that alternative intervention efforts are needed to increase appreciation of addiction [52].

Control information about self-efficacy and treatment efficacy for quitting also reduced the perceived effectiveness of warnings for all smoking status groups, consistent with evidence from recent studies [6, 38]. These findings appear to conflict with theory and research that efficacy beliefs are critical for motivating protective behavior [26] and warrant further exploration in future research. For example, researchers can test whether these messages effectively alter self-efficacy and response efficacy beliefs. In addition, researchers can explore whether, in this context, efficacy messages promote confidence that one can quit in the future so that it is not urgent to do so immediately.

Specific media features were associated with a warning’s perceived effectiveness. Use of photographs (rather than text messages or drawings) increased the odds of warning selection for all smoking status groups, and medical technology images (e.g., X-rays or ultrasound images) did so for smokers and male ex-smokers. In contrast, metaphoric images reduced

the odds of warning selection for all groups. These findings add to recent evidence suggesting that photographic images increase the impact of graphic warnings whereas metaphoric images decrease their impact [6, 47]. Further research can examine why these media attributes might lead to these differences in perceived effectiveness. For example, research can test whether photographs and medical technology images (relative to drawings and text) are more impactful because they heighten the realism and salience of the harms and whether metaphoric messages are less impactful either because their aesthetic appeal makes them relatively less aversive or because they require more cognitive elaboration to comprehend the inferences for smoking risks.

The evidence indicating that media features (or “modality”), such as use of photographs versus drawings, might enhance or detract from the effectiveness of a particular message is supported by research in semiotics [35]. Increasingly, guidance for the creation of behavior change interventions has emphasized the importance of theory and behavior change techniques [53]. Our analysis suggests that modality can be considered in addition to these parameters. The adoption of some media features may enhance or undermine potential impact [54]; indeed, the adoption of multiple modalities has begun to suggest enhanced effectiveness in some cases [55].

Interpretations of the findings should be considered in light of several study limitations. The use of a convenience sample of adults in the UK limits the potential generalizability of the findings to other cultural groups. Moreover, the survey was conducted in 2006, and responses to warnings by UK residents may have changed over time. In particular, residents may have habituated to these labels over this time period. Empirical evidence suggests that smokers and non-smokers habituate to graphic warnings with repeated exposures, such that emotional reactions lessen and plateau over time [56]. Future research can utilize the coding scheme developed for this study to track changes in how attributes predict perceived effectiveness over time and, in countries such as the USA, over the course of the implementation of graphic warnings. Participants viewed the graphic warnings online rather than under the more tactile and contextualized conditions in which they view them on cigarette packs in everyday settings, and the instructions directed their attention to the warnings in ways that may not reflect how they would attend to them in the context of their daily lives. These study conditions may have biased their perceptions of the warnings, and research testing them under more natural conditions is needed. The study used correlational data from an existing survey testing a variety of graphic warnings, and the findings should be followed up with experimental studies in which the attributes and features are systematically manipulated to directly test their causal effects. Future research should also evaluate the impact of representational and media attributes on worry and other emotional

reactions. The CSM and other models highlight the role of worry and related emotions in motivating behavior change [19, 20, 25], and growing evidence indicates that worry mediates the relationships between the informativeness and salience of warnings and both their perceived effectiveness in discouraging smoking [57] and quit attempts [50].

The dependent measure of perceived effectiveness in discouraging smoking is a common outcome measure in studies evaluating the effects of graphic warning labels [6, 38, 47] and represents an important step in the persuasion process, but it may not necessarily reflect effectiveness in other steps in persuasion such as increasing knowledge of the harms of smoking, reducing smoking behavior, or increasing cessation rates. Growing evidence indicates that perceived effectiveness of graphic warnings in motivating smoking cessation is positively associated with thoughts of quitting [47] and quitting intentions [58], both of which are important antecedents to quitting behavior [50]. Further, a national survey of smokers in Australia revealed that the perceived effectiveness of warning labels in motivating them to not smoke prospectively predicted quitting in the subsequent 6 months [59]. Another national survey revealed that a substantial proportion of Canadian smokers both perceived the graphic warning labels as effective in motivating them to quit and reduced or quit smoking and that higher affective responses to labels predicted both greater perceived effectiveness and greater quit attempts, quit rates, and reductions in smoking [8]. Despite these consistent patterns of relationships between perceived effectiveness and quitting thoughts, intentions, and behavior, it is important to note that perceived effectiveness may not translate into behavior change for all individuals. For example, evidence suggests that warnings that increase desires to quit will increase quit intentions only for individuals with sufficient levels of self-efficacy [26, 60].

Finally, it is important to keep perspective that, although warning labels have the potential to contribute to quit motivations, they are unlikely to change smoking behavior on their own. Instead, they are likely to do so when they are included as part of a multi-pronged campaign that simultaneously targets not only desires to quit but also desires to smoke (e.g., through taxes, smoking bans in public areas) and quitting self-efficacy (e.g., with access to smoking cessation support services and media messages targeting self-efficacy beliefs [60]).

To conclude, the present findings provide new insights into how specific features of graphic warnings for cigarettes potentially contribute to their perceived effectiveness in discouraging smoking. Further research is needed to test whether designing graphic warnings to include features predicting greater perceived effectiveness, while avoiding use of those predicting lower perceived effectiveness, improves their impact on smoking motivations and quit attempts. Features may not necessarily have additive effects, and specific configurations might have unique effects, and so research evaluating

interactive effects of features would further progress this approach for creating graphic warnings. The study's methodological approach of using message features identified by theoretically guided content analyses to predict consumer responses can potentially guide further research evaluating graphic health communications.

Statement of Conflict of Interest and Adherence to Ethical Standards Linda D. Cameron and Brian Williams declare that they have no conflict of interest. All procedures were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

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