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Cigarette packaging and health warnings: the impact of plain packaging and message framing on young smokers

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Abstract

Objective—This study examined the impact of pictorial cigarette warning labels, warning label message framing, and plain cigarette packaging on young adult smokers' motivation to quit.

Methods—Smokers ages 18–30 (*n*=740) from a consumer research panel were randomized to one of four experimental conditions where they viewed online images of 4 cigarette packs with warnings about lung disease, cancer, stroke/heart disease, and death, respectively. Packs differed across conditions by warning message framing (gain versus loss) and packaging (branded versus plain). Measures captured demographics, smoking behavior, covariates, and motivation to quit in response to cigarette packs.

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CONTRIBUTOR STATEMENT

Darren Mays conceptualized and designed the study, and led data collection, data analysis, and manuscript preparation. Raymond Niaura and Kenneth Tercyak contributed to study planning, interpretation of data, and manuscript preparation. W. Douglas Evans, David Hammond, and George Luta contributed to interpretation of the data and manuscript preparation. All authors approved the final version of the manuscript to be published.

COMPETING INTERESTS

The authors have no competing interests to disclose.

DATA SHARING STATEMENT

We have access to all data reported in this manuscript and will provide such data on request to the editors or their assignees.

Results—Pictorial warnings about lung disease and cancer generated the strongest motivation to quit across conditions. Adjusting for pre-test motivation and covariates, a message framing by packaging interaction revealed gain-framed warnings on plain packs generated greater motivation to quit for lung disease, cancer, and mortality warnings ($p < 0.05$), compared with loss-framed warnings on plain packs.

Conclusions—Warnings combining pictorial depictions of smoking-related health risks with text-based messages about how quitting reduces risks may achieve better outcomes among young adults, especially in countries considering or implementing plain packaging regulations.

Keywords

warning labels; message framing; young adults

INTRODUCTION

Cigarette smoking is a leading preventable cause of death globally and in the US, where nearly 45 million adults smoke.[1] Due to tobacco marketing restrictions, cigarette packaging has become a crucial promotional medium.[2] Packaging regulations including pictorial health warning labels and restrictions on industry branding are central to global tobacco control, but regulations in the US have allowed the industry to promote smoking through cigarette packs virtually unrestricted.[3] The 2009 Family Smoking Prevention and Tobacco Control Act (the "Act") marked an historic change by authorizing the US the Food and Drug Administration (FDA) to regulate tobacco products, including labeling and packaging. The Act requires new pictorial warning labels for cigarette packs and prohibits the use of misleading product descriptors (e.g., "light" "mild").[4] The Act also authorizes the FDA to update the warnings and to regulate other aspects of packaging, such as additional descriptors and potential modified risk claims on cigarette packaging.[4]

The Act ushered in a need for rigorous tobacco regulatory science to ensure a strong body of evidence exists to support regulatory decisions,[4] and this is particularly evident for the pictorial warning label requirement.[5] Lawsuits from the tobacco industry have prevented implementing the new pictorial warnings and the supporting scientific evidence has come under scrutiny in legal decisions.[4] Most recently, the FDA decided not to appeal the 2012 US Court of Appeal's decision deeming the warnings unconstitutional. Instead, the FDA is seeking additional research to support the implementation of the warnings as required by the Act.[4]

Scientists and policymakers have identified research that can inform the implementation of pictorial warning labels in the US, including studies determining how to optimize pictorial warning label impact on public health, how warnings affect smoking cessation in high-risk subgroups, and how additional packaging regulations (e.g., standardized plain packaging) may promote public health.[3] Among the groups where packaging regulations could be effective at reducing smoking, young adult smokers stand out. Young adults identify with tobacco brands based on packaging, and tobacco companies target this group with carefully designed cigarette packs.[6] Nearly 20% of US young adults ages 18–30 are current smokers and many transition to regular smoking during this time.[1,7] Quitting smoking by age 30

reduces the lifetime risk of tobacco-associated disease to nearly that of a non-smoker,[8] but few young adults successfully quit.[9] Although young adults are a priority population for tobacco control, research to optimize the impact of pictorial warning labels and other packaging regulations in this population has lagged.[3,10]

Many prior studies have examined the impact of cigarette warning labels and other packaging regulations,[3] but two recent experiments are germane to this study. Hammond and colleagues[11] investigated perceived effectiveness of FDA pictorial warning labels among US adults. Warnings about cancer, lung disease, stroke/heart disease, and mortality were perceived to be most effective for deterring smoking and perceived effectiveness increased with younger age.[11] Cameron and colleagues[10] examined the impact of FDA pictorial warnings on fear/anxiety, perceived risks, and motivation to avoid smoking among young adults. Pictorial warnings had a stronger impact than text-only warnings and findings were similar with respect to health-related warning themes.[10] Although these studies are informative, many important questions remain about how to optimally design pictorial warnings and leverage other packaging regulations to promote cessation among young adults. This includes gaining a deeper understanding of which FDA proposed warnings may be impactful in this population, how the contents of warnings could be adapted to enhance impact, or how warnings could be implemented with other regulations on industry branding to achieve optimal public health outcomes. These questions have implications for tobacco control globally as many countries consider how to optimally apply pictorial warnings and other packaging regulations to promote public health.

We sought to address these knowledge gaps by investigating the impact of four pictorial warning labels, warning label message framing, and plain packaging on young adult smokers' motivation to quit. Message framing stems from a behavioral theory called Prospect Theory and posits that conveying information about the health risks of smoking (i.e., loss-framed) or the benefits of quitting (i.e., gain-framed) may differentially affect smokers' behaviors. Research on message framing suggests that loss-framed messages are more effective for promoting screening/early detection behaviors while gain-framed messages are optimal for disease prevention behaviors, including quitting smoking.[12] Studies on smoking indicate gain-framed messages about cessation are more impactful than loss-framed messages, especially among smokers who are ready to quit.[13] This evidence suggests that depicting smoking-related risks through images and communicating information about the benefits of quitting with gain-framed message text may prove optimal because they could influence multiple cognitive and emotional processes, including emotional response (e.g., fear), raising awareness of health risks, and enhancing beliefs that quitting reduces risk.[14] Plain packaging that removes industry branding (e.g., images such as Marlboro's chevron) was recently implemented in Australia in combination with pictorial health warnings and has been discussed as a tobacco control measure in other settings. Research indicates that plain packaging reduces positive perceptions of packs and increases attention to warnings, which may enhance their impact for promoting cessation.[15]

Given this evidence, this study was designed with two objectives in mind: (1) identify which pictorial warnings proposed for use in the US have the strongest impact on motivation to quit among young adult smokers; (2) examine the effects of warning message framing (gain

versus loss) and packaging (branded versus plain) on cessation motivation. We hypothesized pictorial warnings with gain-framed messages appearing on plain cigarette packs would have the strongest impact on motivation to quit among young adult smokers.

METHODS

In 2013, we sampled US young adult smokers ages 18 to 30 who were members of a market research panel maintained by YouGov, Inc. (Palo Alto, CA). The panel includes approximately 1.2 million US adults recruited through Internet-based advertisements, e-mail, and other methods to participate in online surveys. Purposive sampling for this study occurred in two steps. We first determined the demographic characteristics of US young adult smokers using data from the 2011 National Health Interview Survey, a national survey conducted by the US Centers for Disease Control and Prevention.[1] Sample targets were created based on the proportion of young adult smokers in strata for age (< 25 years, 25 – 30 years), race/ethnicity (white and other groups, black/African American, Hispanic) and education (≤ high school, some college, college degree, graduate degree). These proportions were used to target invitations and monitor accrual in an effort to maintain demographic diversity.

Panel members in the target age range were invited to participate through an e-mail with a link to an IRB-approved informed consent form describing the study. Participants consented through a yes/no item then responded to three valid items assessing eligibility based on age and smoking status.[1] Those who confirmed their age was between 18 and 30, had smoked ≥ 100 lifetime cigarettes, and currently smoked on all or some days were eligible. The raw response rate among eligible panel members was 19%, comparable to similar Internet-based young adult smoking research.[16]

After completing a series of behavioral measures, participants were randomly assigned to one of four experimental conditions in a two-by-two factorial design. In each condition participants viewed images of four adapted cigarette packs each of which displayed a pictorial warning, which was treated as a within-subjects factor in analyses. Participants viewed all four pack images presented in the same manner on a single screen for as long as they wished with the item assessing cessation motivation directly below each image. Packs with warnings about stroke/heart disease and lung cancer appeared in the first row; packs with warnings about cancer and mortality were in the second row. Pack images varied across experimental conditions by (1) framing of the warning message text (gain versus loss) and (2) packaging (plain versus branded). Pictorial warnings communicating smoking-associated risks of lung disease, cancer, stroke/heart attack, and mortality were selected from the nine warnings proposed by the FDA based on findings of two recent experiments.[10,11] Warnings covered 50% of the pack face, consistent with the Act's requirements.

Warnings in the loss-framed condition were those proposed by the FDA conveying health risks of smoking (e.g., *Cigarettes cause cancer*). Based on message framing research, to create gain-framed versions we adapted the warning label message text to emphasize the benefits of quitting (e.g., *Quitting smoking reduces the risk of cancer*).[12] All cigarette packs used images from the FDA-proposed warning labels; loss-framed warnings also used the

text from the FDA labels and gain-framed warnings showed text that was adapted to emphasize the health benefits of cessation. The study included two gain-framed warning conditions: the standard gain-framed warnings and a second condition with personalized gain framed warnings (e.g., *Quitting smoking can reduce your risk of cancer*). We confirmed through our statistical analyses the decision to group both types of gain-framed warnings together did not affect our findings, therefore we maintained the two-by-two design for analyses.

Pack images used a brand unfamiliar to US smokers to account for smokers' brand preferences.[17] Branded packs were created using a pack image freely available from the Tobacco Labeling Resource Library (www.tobaccolabels.ca). Plain packs displayed the brand name in standard font and were brown color.[18] Although the size of the image depended on participants' computer screens, images were scaled to the dimensions of a standard US cigarette pack, spaced equally apart, and shown in the same layout for all participants. Please see the online Supplementary Appendix for pack images used in the experiment.

All procedures were reviewed and approved by Georgetown University's Institutional Review Board.

Measures

Demographics and Smoking Behavior—Demographics included self-reported age, gender, race/ethnicity, education, marital status, and annual income. Smoking behaviors assessed included cigarettes smoked per day, daily or non-daily smoking, and preferred brand.[1]

Baseline Motivation to Quit—Baseline motivation to quit smoking was captured before participants viewed cigarette pack images using four reliable and valid items.[19] Participants responded on a Likert-type scale ranging from one ("Definitely will not") to four ("Definitely will"). Responses were averaged to create a summary score with higher scores indicating greater motivation to quit (Cronbach's $\alpha = .89$).

Outcome Variable—The primary outcome was participants' motivation to quit reported in response to the cigarette pack images. Participants indicated how much each pack image motivated them to quit smoking through a single, seven-point response item anchored at one ("Not At All") and seven ("A Lot").[16] We examined participants' motivation to quit in response to each pack image and average motivation across all four packs (Cronbach's $\alpha = .92$). We selected a different item for the outcome measure to avoid habituation that may occur from using the same questions at baseline and in response to pack images. Items for the baseline and outcome measures are included in the online Supplementary Appendix.

Manipulation Checks—To check the message framing manipulation, we included a single item after participants viewed the cigarette packs that read "*The information on the packs focused on the benefits of quitting smoking*" with a five-point Likert-type response ranging from one ("Strongly Disagree") to five ("Strongly Agree").[20] Plain packaging has been shown to increase occasional smokers' attention to pictorial cigarette warnings using

methods such as eye-tracking.[21] We examined success of the plain packaging manipulation using an item adapted from a prior study to assess whether participants could recall the brand of cigarette packs shown as a proxy for attention to branding.[22] Response options included Marlboro, Camel, Peter Jackson (the correct brand), and Newport. A binary variable indicating whether participants recalled the brand (i.e., greater brand attention) or did not (i.e., lower brand attention) was analyzed.

Statistical Analysis

Bivariate tests (i.e., *F* tests, χ^2 tests) comparing demographic and smoking-related characteristics across the four experimental conditions were used to assess randomization success. Bivariate tests (i.e., *t* tests, *F* tests) were also used to identify demographic and smoking-related variables associated with study outcomes for inclusion as covariates in multivariable analyses. A similar series of bivariate tests as well as multivariable regression were used to determine the success of our experimental manipulations. To examine differences in motivation to quit between the four warning labels (lung disease, cancer, heart disease/stroke, death), we used paired *t* tests in the full sample and separately by experimental condition. For each set of *t* tests we used a Bonferroni correction (critical $\alpha = .05/4$ given four tests) to adjust for multiple comparisons.

Analysis of covariance (ANCOVA) was then used to assess differences in motivation to quit on average for all packs and individually for each of the four warnings based on framing and packaging. Demographic and smoking-related characteristics associated with outcome variables in bivariate analyses ($p < .05$) were included as covariates. Main effects for message framing and packaging and their interaction were first inspected. Based on the findings, we evaluated pair-wise adjusted least square mean differences between all four study conditions using Tukey's post-hoc adjustment.

RESULTS

Sample Characteristics

Characteristics of the sample are shown in Table 1. Participants were on average 23.8 years of age (SD 3.1), 45% were female, 75% were non-Hispanic white race/ethnicity, and most (72%) had less than a college education. On average, participants smoked 9.2 (SD 8.9) cigarettes/day and nearly two-thirds were daily smokers (64%; Table 1). There were no significant differences with respect to demographic or smoking-related characteristics across conditions, indicating successful randomization (data not shown).

Manipulation Checks

Participants randomized to view packs with gain-framed warnings indicated the warnings emphasized the benefits of quitting (*M* 3.2, *SD* 1.4, range 1–5) significantly more than participants randomized to view packs with loss-framed warnings (*M* 2.8, *SD* 1.5, $t = 3.5$, $p < .001$). Participants randomized to view branded packs were more likely to recognize the brand (53%) compared with participants who viewed plain packs (45%, $\chi^2 = 3.56$, $p = .056$). In a logistic regression model adjusting for demographic and smoking-related factors associated with brand recognition in bivariate analyses (pre-test motivation to quit,

cigarettes/day, preferred brand, gender, race/ethnicity, employment, and income) this difference was statistically significant ($\chi^2 = 4.45$, $p = .035$). These findings indicate both manipulations were successful.

Bivariate Associations with Motivation to Quit

Bivariate associations between demographic and smoking-related characteristics and motivation to quit in response to the four warning labels are shown in Table 1. Although we examined bivariate relationships for average motivation across warnings and for the four warnings individually, the patterns were similar across all outcomes so associations with average motivation to quit are shown for conciseness. Motivation to quit was higher among non-white racial/ethnic groups, those who were married or in a partnership, employed full time, and those with a household income ≥ $US 50,000/year. Motivation was negatively associated with cigarettes smoked/day, positively associated with pre-test cessation motivation, and varied by participants' preferred brand (Table 1).

Motivation to Quit Outcomes

Overall and by study condition, motivation to quit in response to warnings about lung disease and cancer was higher than the warning about stroke/heart disease (Table 2). With the exception of the loss-framed plain packaging condition, the mortality warning also prompted stronger motivation to quit than the stoke/heart disease warning across conditions (Table 2).

Table 3 shows test statistics and effects from the ANCOVA examining differences in motivation to quit between experimental conditions. After adjusting for baseline motivation and demographic and smoking-related characteristics, there were no significant main effects for message framing and branding. There was a significant interaction between message framing and packaging for average motivation to quit across warnings ($F = 4.91$, $p = .027$) and this interaction was significant for the warnings about lung disease ($F = 5.11$, $p = .024$), cancer ($F = 6.58$, $p = .011$), and mortality ($F = 5.67$, $p = .018$)(Table 3).

Pair-wise comparisons of least squares means between experimental conditions are shown in Table 4. There was an overall trend suggesting participants who viewed gain-framed warnings on plain packs reported greater motivation to quit ($M = 5.2$, $SE = 0.17$,) than participants who viewed loss-framed warnings on plain packs ($M = 4.7$, $SE = 0.21$, $p = .095$). Inspection of adjusted mean differences by condition showed that gain-framed warnings on plain packs prompted significantly greater cessation motivation than loss-framed warnings on plain packs for warnings about lung disease (gain-framed $M = 5.5$, $SE = 0.18$, loss-framed $M = 5.0$, $SE = 0.23$, $p = .043$), cancer (gain-framed $M = 5.6$, $SE = 0.19$, loss-framed $M = 5.1$, $SE = 0.23$, $p = .035$), and mortality (gain-framed $M = 5.3$, $SE = 0.20$, loss-framed $M = 4.7$, $SE = 0.24$, $p = .041$)(Table 4).

DISCUSSION

Our findings show that, among US young adult smokers, FDA-proposed warnings about cancer, lung disease, and smoking-related mortality evoked stronger motivation to quit than warnings about stroke/heart disease. The results also show that on branded packs, pictorial

warnings with gain- and loss-framed message text prompted similar cessation motivation. On plain packs without industry branding, warnings combining pictorial depictions of health risks with gain-framed message text generated stronger motivation to quit.

Our results complement and extend those of two recent experiments examining the impact of FDA-proposed pictorial warnings. The results were consistent with these studies in that warnings about cancer, lung disease, and smoking-related mortality were among those perceived to be the most effective.[10,11] Our work builds from these studies by demonstrating consistent results when smokers' cessation motivation is the focal outcome and when warning text is framed to emphasize the benefits of quitting. The relatively lower impact of the warning about stroke/heart disease may be because it is less "graphic" than other warnings examined in that it does not use a gruesome image depicting smoking-related health consequences, an important feature that influences impact.[10,11] This finding could also be because young adults are less aware of smoking-related health consequences such as stroke/heart disease.[23] The latter suggests a possible opportunity for educating young adults about the negative health effects of smoking other than cancer and lung disease to promote cessation; however, research is needed to further examine potential reasons for this finding.

Our results offer new insights on the role of message framing in designing pictorial warning labels and also highlight the importance of testing independent and interactive effects of text and imagery of pictorial warnings in future studies. In the context of branded packaging, warnings with gain- and loss-framed text performed equivalently. Governments face the dual challenge of identifying warning label content with optimal public health impact, and varying warnings over time to prevent habituation and burnout..[3] As tobacco regulators in the US and other countries consider ways to vary warning label content, warnings pairing gain-framed text with pictorial depictions of health risks provide a potentially effective means of diversifying messages that smokers receive without diminishing impact.

Global momentum surrounding plain cigarette packaging regulations is increasing, with Australia adopting a plain packaging requirement in 2012 and other countries considering similar regulations. Our results indicate that, in contexts where plain packaging requirements are enacted, regulators should consider warnings with gain-framed content (emphasizing the benefits of quitting smoking) to optimize their impact. Our findings suggest a synergistic effect between health warnings with gain-framed messaging and plain packaging, creating the potential for enhanced public health impact when these regulations are implemented together. This could be because plain packaging removes the distraction of industry branding and decreases the appeal of cigarette packs, which may promote greater attention to and processing of warning labels.[15,21,24] Prior studies point to potential mechanisms through which gain-framed warnings influence smokers' motivation to quit in the context of plain packaging;[14] these include the potential for such warnings to elicit an emotional response (e.g., fear, anxiety), raise awareness of smoking-related health risks, or enhance smokers' beliefs that quitting reduces risk.

The results of our study should be considered in light of important limitations. Although the sampling strategy was designed to maintain demographic diversity, the study was conducted among members of an Internet market research panel which may reduce generalizability.

Our study investigated subtle changes in reframing the text of pictorial warning labels: we adapted only the message text and other alterations (e.g., gain-framed imagery) should be investigated. Since all four pack images were presented on a single screen, we are unable to determine whether ordering effects may have occurred, which is an important limitation that should be addressed in future experiments. We assessed outcomes after a single, brief exposure to pack images and relied on self-reported motivation to quit. The effect sizes were modest and this design does not provide data on smokers' behaviors after repeated exposures. Future research is needed to address these limitations by applying prospective experimental designs that realistically capture the impact of packaging regulations on smokers' behaviors[24] and by using objective assessments of reactions to warning label messaging and plain packaging (e.g., eye tracking,[21] neuroimaging[25]).

Despite these limitations, our results suggest a combination of graphic warning labels with gain-framed text and plain cigarette packaging may be an optimal regulatory strategy to promote cessation among young adult smokers. This is a population at risk for nicotine dependence, with poor cessation outcomes, and highly susceptible to industry marketing.[7,9] A combination of strategically-framed health warning messages and regulations to reduce industry branding may produce better population-level cessation outcomes for young adult smokers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What this paper ads?

Message framing is a strategy that could be leveraged to vary the contents of pictorial cigarette warning labels as they are implemented over time. Warnings combining pictorial depictions of the health risks of smoking and message text conveying the health benefits of quitting may achieve better outcomes among young adult smokers, especially in contexts where plain packaging is required.

Table 1

Sample characteristics & bivariate associations with motivation to quit in response to adapted cigarette packs

	Study Sample (*n* = 740)	Association with Motivation to Quit*		
Demographics		*Mean* (*SD*)	Correlation (*r*)	*P*
Gender				.930
Male	55.5% (411)	4.8 (1.8)		
Female	44.6% (329)	4.8 (1.9)		
Age *M (SD)*	23.8 (3.1)		−0.01	.888
Race				<.001
Non-Hispanic White	74.9% (554)	4.6 (1.9)		
Non-Hispanic Black	10.7% (79)	5.7 (1.4)		
Other Minority	14.4% (107)	5.3 (1.6)		
Education				.248
College or Greater	27.7% (205)	4.9 (1.6)		
Less than College	72.3% (535)	4.8 (1.9)		
Marital Status				.032
Married/Partnership	31.3% (231)	5.1 (1.7)		
Single – Never Married	64.4% (476)	4.7 (1.9)		
Other	4.3% (32)	4.5 (2.0)		
Employment				.030
Full Time Employed	38.0% (281)	5.0 (1.7)		
Other/Not Employed	62.0% (468)	4.7 (1.9)		
Income				.014
≥ $50,000/year	29.5% (218)	5.1 (1.6)		
< $50,000/year	63.1% (467)	4.7 (1.9)		
No data/Prefer not to say	7.4% (55)	4.3 (2.1)		
Cigarette Smoking				
Cigarettes/Day	9.2 (8.9)		−0.07	.038
Baseline Motivation to Quit	2.6 (0.78)		0.33	<.001
Daily Smoker				.410
Yes	63.8% (472)	4.8 (1.8)		
No	36.8% (268)	4.9 (1.9)		
Preferred Brand				<.001
Camel	18.5% (137)	4.8 (1.8)		
Marlboro	44.3% (328)	4.8 (1.9)		
Newport	16.2% (120)	5.3 (1.7)		
Other	21.0% (155)	4.4 (1.8)		

*Motivation to quit outcome averaged across the 4 adapted cigarette pack images participants viewed

Table 2

Mean (standard deviation) differences in motivation to quit smoking overall and by experimental condition

		Experimental Conditions			
Warning Label	**Overall *n* = 740**	**Loss-Framed Branded Packs *n* = 123**	**Gain-Framed Branded Packs *n* = 253**	**Loss-Framed Plain Packs *n* = 131**	**Gain-Framed Plain Packs *n* =233**
Lung Disease (A)	5.1 (2.0)^{C,D}	5.1 (2.1)^{D}	5.0 (2.0)$^{C, D}$	4.8 (2.0)^{D}	5.4 (1.8)^{C,D}
Cancer (B)	5.2 (2.0)^{C,D}	5.2 (2.1)^{D}	5.1 (2.0)$^{C, D}$	4.9 (2.0)^{C,D}	5.5 (1.8)^{C,D}
Mortality (C)	4.8 (2.1)^{A,B,D}	4.9 (2.2)^{D}	4.8 (2.0)^{A,B,D}	4.5 (2.2)^{B}	5.1 (2.0)^{A,B,D}
Stroke/Heart Attack (D)	4.3 (2.1)^{A,B,C}	4.4 (2.0)^{A,B,C}	4.2 (2.1)^{A,B,C}	4.1 (2.2)^{A,B}	4.4 (1.9)^{A,B,C}

Motivation to quit was captured on a 7-point scale with higher values indicating stronger cessation motivation. Superscript letters adjacent to means within a column indicate significant differences at an overall alpha of 0.05 in paired *t* tests between warning labels using a Bonferroni adjustment for multiple comparisons

Table 3

Analysis of covariance (ANCOVA) test statistics for motivation to quit smoking by message framing (gain or loss), cigarette pack branding (plain or branded), and their interaction

	ANCOVA Results									
	Average Across Warnings		Lung Disease		Cancer		Mortality		Stroke/Heart Attack	
	F	Partial η^2	*F*	Partial η^2	*F*	Partial η^2	*F*	Partial η^2	*F*	Partial η^2
Main Effects										
Branding	0.29	0.0004	0.37	0.0005	0.05	0.0001	0.65	0.0009	0.18	0.0003
Message Framing	1.15	0.002	2.18	0.0031	1.61	0.002	1.93	0.003	0.13	0.0002
Interaction Effects										
Branding × Message Framing	4.91*	0.007	5.11*	0.007	6.58*	0.009	5.67*	0.008	1.48	0.002

Covariates included in the ANCOVA were baseline motivation to quit, cigarettes smoked/day, preferred brand, and demographics (race/ethnicity, income, employment, and marital status).

* $p < 0.05$

Table 4

Adjusted pair-wise mean (standard error) differences in motivation to quit smoking between study conditions

Motivation to Quit Smoking	Loss-Framed Branded Packs (A)	Gain-Framed Branded Packs (B)	Loss-Framed Plain-Packs (C)	Gain-Framed Plain Packs (D)
Average Across All Warnings	5.1 (0.20)	5.0 (0.17)	4.7 (0.20)	5.2 (0.17)
Lung Disease Warning	5.5 (0.22)	5.3 (0.18)	5.0 (0.23)[D]	5.5 (0.18)[C]
Cancer Warning	5.4 (0.23)	5.3 (0.19)	5.1 (0.23)[D]	5.6 (0.19)[C]
Death Warning	5.2 (0.24)	5.0 (0.19)	4.7 (0.24)[C]	5.3 (0.20)[D]
Stroke/Heart Attack Warning	4.5 (0.23)	4.4 (0.19)	4.3 (0.23)	4.5 (0.19)

Motivation to quit based on scale from 1 to 7 with higher values indicating stronger motivation. Average motivation is across all 4 pictorial warnings; warning specific motivation is for each individual pack image viewed. Superscript letters adjacent to means indicate significant differences at $p < 0.05$ in pair-wise comparisons of adjusted means between study conditions after Tukey's post hoc adjustment. Means are adjusted for baseline motivation to quit, cigarettes smoked per/day, preferred cigarette brand, and demographics (race/ethnicity, income, employment, and marital status) based on the results of bivariate analyses.