Estimating the impact of pictorial health warnings and "plain" cigarette packaging: Evidence from experimental auctions among adult smokers in the United States

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ABSTRACT

Objective: To estimate differences in demand for cigarette packages with different packaging and health warning label formats.
Methods: Adult smokers (*n* = 404) in four states participated in experimental auctions. Participants bid on two of four experimental conditions, each involving a different health warning label format but with the same warning message: (1) text on 50% of pack side; (2) text on 50% of the pack front and back; (3) text with a graphic picture on 50% of the pack front and back; and (4) same as previous format, but without brand imagery.
Results: Mean bids decreased across conditions (1: $3.52; 2: $3.43; 3: $3.11; 4: $2.93). Bivariate and multivariate random effects models indicated that there was no statistically significant difference in demand for packs with either of the two text only warnings; however, demand was significantly lower for both packs with prominent pictorial warnings, with the lowest demand associated with the plain, unbranded pack.
Conclusions: Results suggest that prominent health warnings with graphic pictures will reduce demand for cigarettes. Regulators should not only consider this type of warning label, but also plain packaging policies for tobacco products.

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1. Introduction

The 2009 Family Smoking Prevention and Tobacco Control Act gave the United States' Food and Drug Administration (FDA) regulatory authority over the cigarette package health warning labels (HWLs), as well as over marketing and packaging that mislead consumers about the safety of tobacco products [1,2]. Current US HWL policy has been in force since 1984 and involves four rotating messages that appear on approximately 50% of the side of the cigarette pack. The new warnings, which are scheduled to appear by October 2012, will include eight messages accompanied by pictures that will appear on 50% of both the front and back of cigarette packages (see Table 1). This policy is consistent with recommended standards for the World Health Organization's Framework Convention on Tobacco Control (WHO-FCTC) [3,4]. Furthermore, it builds upon the evidence base indicating that prominent HWLs that combine pictures and text are more effective than text-only messages in engaging smokers, increasing knowledge about risks, promoting thoughts about quitting, and decreasing demand for cigarettes [5–13].

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Table 1
History of warning label changes in the United States.

Year of policy	Warning label message
1966	*Caution:* Cigarettes smoking may be hazardous to your health
1969	*Warning:* The Surgeon General has determined that cigarette smoking is dangerous to your health
1984	*Surgeon general's warning:* Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy
	Surgeon general's warning: Quitting smoking now greatly reduces serious risks to your health
	Surgeon general's warning: Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight
	Surgeon general's warning: Cigarette smoke contains carbon monoxide
2011	Cigarettes are addictive
	Tobacco smoke can harm your children
	Cigarettes cause cancer
	Cigarettes cause strokes and heart disease
	Smoking during pregnancy can harm your baby
	Smoking can kill you
	Tobacco smoke causes fatal lung disease in nonsmokers
	Quitting smoking now greatly reduces serious risks to your health

Studies mainly conducted outside of the US find that pictorial HWLs that show gruesome, diseased organs or human suffering due to smoking appear to have a greater impact on smokers than more abstract imagery [14–19]. Furthermore, such imagery may have its greatest impact among populations with lower educational attainment [13]. Indeed, other research indicates that emotionally evocative ads and testimonials work better among lower than higher SES groups [20]. Similar to the greater price sensitivity found among low-income smokers [21], pictorial HWLs could help remediate the disparate concentration of smoking within socially disadvantaged groups [22].

In addition to calls for pictorial HWLs, researchers and advocates increasingly call for tobacco products to come in "plain" packages, which would eliminate color and brand imagery [23,24]. The rationale for plain, unbranded packaging includes studies showing that false beliefs about the reduced risks associated with different brand varieties persist, in spite of the removal of deceitful brand descriptors, like light or mild [25]. Indeed, the persistence of false beliefs may be due to brand imagery and color [26,27], as indicated in tobacco industry documents from Philip Morris: "as one moves down the delivery sector, then the closer to white a pack tends to become. This is because white is generally held to convey a clean healthy association."[28]. Aside from reducing false health beliefs, plain, unbranded packaging appears to increase the noticeability, recall and believability of health warnings [29,30] and to reduce brand appeal among both adults [31] and youth [32–34]. We hypothesize that smokers will have a lower demand for plain, unbranded cigarettes then for the same cigarettes in branded packaging.

In this study, we used the experimental economics method of auctions [35] among adult smokers in four US cities in order to estimate differences in demand associated with different health warning label formats and plain, unbranded packaging. Experimental auction participants actually purchase any products they win. Because of the immediate monetary consequences, experimental auctions may be preferable to hypothetical valuation techniques such as hypothetical choice experiments [36] or hypothetical auctions [37]. A metaanalysis comparing real and hypothetical valuations finds that hypothetical valuations exceed real valuation by a factor of three on average [38].

2. Methods

2.1. Participant recruitment and sample size

The study protocol was approved by the IRB at the University of South Carolina. Tables were set up at grocery stores in four cities: Selinsgrove, PA; Columbia, SC; Tampa, FL; and San Diego, CA between May and September 2009. Eligible study participants were 18 and older, had smoked more than 100 cigarettes in their lifetimes, had smoked at least one cigarette in the last month, and were not pregnant. Posted signs indicated that adult smokers could earn $15 for 15 min of their time. Auctions were conducted with one to eight participants at a time, and a total of 402 participated.

2.2. Experimental conditions

The study involved assessing four health warning label (HWL) conditions (see Fig. 1), all with the same novel message (i.e., *smoking causes mouth cancer*), which is not currently on US HWLs: (1) text-only message that covered 50% of one side of the package (current US policy); (2) text-only message that covered 50% of the lower half of the front, back and one side of the package; (3) text message with pictorial image of mouth cancer, covering 50% of the lower half of the front, back and one side of the package; (4) the same text and pictorial image as in condition 3, but mostly unbranded, i.e., with all color and symbolic brand elements removed, aside from the brand font, size and descriptors. Note that the front-text and graphic image HWL (2 and 3) used the original brand packaging. For the Marlboro packs, the distinctive chevron was shown on the front and back of the package, but the brand name was only shown on the top and bottom of the package. For the branded Newport packs in these conditions, the brand name and imagery was shown on the front and back of the package, because the name is located in the upper part of the package. Eligible participants were randomly assigned to bid on one of five package conditions (i.e., 1 and 2; 1 and 3; 2 and 3; 2 and 4; 3 and 4), each of which involved random ordering of presentation and bids.

All four HWL conditions were affixed to the three most popular brands within major product classes (i.e., Marlboro "Red," Marlboro Lights and Newport Menthol). At the beginning of the study, participants indicated their preference for full flavor, light or mentholated cigarettes, and

Fig. 1. Labels used in the experiment.

their subsequent participation involved bidding on the corresponding most popular brand within this preferred class. Even when the brand on which a participant bid was not her preferred brand, she bid on the same brand throughout the study; hence, biases introduced by any lesser preference should equally influence all bids placed and thereby minimize this possible bias.

2.3. Experimental design

Experimental auctions, first developed in the 1960s, have recently been used to assess US smokers' demand for low and no nicotine cigarettes [39], as well as demand among adult Mexicans for cigarettes with pictorial *vs.* text-only warning labels graphic labels [40].

For the present study, data were collected using the Becker–DeGroot–Marschak (BDM) auction mechanism (Becker et al. [43]), in which participants are initially given enough money to compensate for their time and to provide them with more than enough money to pay the "clearing" price for the product of interest. Each participant is given the product to examine and asked to place a bid on that product reflecting how much they would be willing to pay for it. Participants are told that this auction is different from other auctions in that they can only bid once and it is in their best interest to submit a bid equal to the full price

they are willing to pay for the product. Next, a fixed price is selected randomly from a uniform distribution of prices. If a participant bids more than this randomly selected price, he or she purchases the product *paying the selected price*; a participant who bids less than the selected price does not purchase the product.

This BDM auction is "demand revealing" in that it is in a participant's best interest to bid his or her true value (demand) for the product. This is in contrast with the more familiar first-price, sealed-bid auction (FPSBA) [41], where the highest bidder wins the auction and pays a price equal to her bid. The FPSBA is not demand revealing because participants have an incentive to submit bids lower than their true value. Underbidding can increase expected pay-off because, while it reduces a participant's probability of winning the auction, it increases her payoff if she does win. Participants in a BDM mechanism have no incentive to understate their true value because the price auction winners pay is determined by a random draw, not their bid. Someone who bids higher than her true value for the product could end up paying more than that true value. Someone who bids lower than her true value may miss out on a profitable purchase if the randomly selected binding price is less than her true value buy higher than the bid she submitted. Unlike surveys and focus groups, participants in the experimental auction make decisions that have true financial impact [42]. In other words, auction winners pay for and receive the product, just as they would in the marketplace. Although this method does not assess cognitive impact or provide psychological explanations for differences in demand, it captures a behavioral outcome (i.e., purchasing the product) that may be considered more proximal to desired behavioral impact than self-reported psychosocial indicators. This method offers the additional advantage of allowing greater experimental control over transaction conditions than studies of naturally occurring market transactions. For more on the properties of this auction, see Becker et al. [43] or Corrigan and Rousu [44].

2.4. Experimental protocol

After screening for eligibility and signing consent forms, participants filled out a brief survey on smoking behavior and received a detailed explanation of the BDM auction. Participants were explicitly informed that it was in their best interest to bid their true value for the products, no more and no less. Any questions they had were answered and a practice round was conducted in which participants bid separately on two candy bars.

Participants were then presented with and bid on a cigarette pack. Once this was done, participants were presented with and bid on the second pack. Next, the binding auction round (i.e., which pack would be auctioned) was randomly determined. The selected price was then randomly chosen from a uniform distribution, which ranged from $0.10 to $10.00 in increments of $0.10. If the participant bid more than this value, she paid the selected price and received the package.

2.5. Measurement

Smoking-related variables: Before the study began, participants were asked standard questions on sociodemographics, smoking history, cigarette consumption, preferred brand and intentions to quit.

2.6. Analysis

To examine the possible impact of demographic and smoking-related characteristics and bids, as well as to control for multiple bids by each individual, we estimated random effects regression models. Bids were the dependent variable, and dummy variables were used to indicate experimental conditions, with the current US labeling format as the reference group. Analyses were first run with just these dummy variables indicating experimental condition. Next, sociodemographic and smoking-related variables were entered and then removed from the model, one at a time. Finally, the full random effects regression model was estimated in the following way:

$$BIDit = \alpha_i + \delta'L_i + \beta'X_i + \gamma'C_i + \varepsilon_{it} \qquad (1)$$

where *BIDit* is participant *i*'s bid in for the pack with label *t*, α_i is a random effects intercept term; L_i is a vector that represents which label the participant was bidding upon and δ' is the associated coefficient vector; X_i is a vector that represents which the demographic characteristics of participant *i* and β' is the associated coefficient vector; C_i is a vector that represents the smoking-related characteristics of participant *i* and γ' is the associated coefficient vector, and ε_{it} is the error term. Finally, sensitivity analyses were conducted using linear regression, wherein we regressed only the first bid on experimental condition indicators, sociodemographics and smoking-related variables.

3. Results

Table 2 shows the characteristics of the overall sample, as well as of the samples within each cigarette package bid condition. The mean age of participants was 38.0 years old, and 44% of the sample was female. Fifty-nine percent of the sample was white, 36% black, and 5% identified as a different ethnic or racial background. Almost half (45%) of the sample had household incomes below $15,000 and 60% had a high school degree or less. Study participants smoked an average of 16.5 cigarettes a day, and 56% indicated they were either currently trying or planning to quit smoking within the next 6 months.

Table 3 shows how the bids varied by labeling condition. The mean bid on the control condition packs with current HWL specifications was $3.52 while the median was $3.50. The mean bid for the larger, text only HWL was $3.43 while the median was $3.50. The mean bids for the pictorial HWL and the pictorial with plain, unbranded packaging were $3.11 and $2.93, respectively (medians were $3.00 for both).

Random effects models that regressed bids on the experimental conditions produced consistent results regarding the statistically significant, lower bids for cigarette packages with pictorial HWLs, in both bi-variate

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Table 2
Sample characteristics of study sample and associated experimental conditions.

		Control text (N=172)	Larger text (N=252)	Picture and text (N=234)	Picture, text and plain package (N=146)	Total bids on all products* (N=804)
Age (mean)		38.0	37.8	38.2	38.0	38.0
Female		45%	47%	42%	42%	44%
Race/ethnicity	White	61%	60%	61%	60%	55%
	Black	33%	33%	36%	34%	41%
	Other	6%	7%	3%	5%	4%
Annual household income	Less than $15,000	41%	45%	45%	44%	44%
	$15,000–$35,000	34%	37%	33%	35%	38%
	More than $35,000	25%	18%	22%	21%	19%
Educational attainment	Less than HS	20%	16%	15%	17%	13%
	HS degree but no college	33%	40%	44%	40%	47%
	At least some college	47%	44%	41%	43%	40%
# of cigarettes per day		16.6	15.9	17.0	16.7	16.5
Intend to quit within the next six months		51%	57%	58%	54%	55%

Note: Some percentages add up to more than 100% due to rounding (e.g. income).
* Each participant bid twice, so there were 402 × 2 bids.

Table 3
Bids for cigarettes by participants.

	Control text (N=172)	Larger text (N=252)	Picture and text (N=234)	Picture, text and plain package (N=146)	Total bids on all products (N=804*)
Bid (mean)	$3.52	$3.43	$3.11	$2.93	$3.25
Bid minimum	$0.00	$0.00	$0.00	$0.00	$0.00
25th percentile	$2.91	$2.50	$2.00	$1.56	$2.25
Bid (median)	$3.50	$3.50	$3.00	$3.00	$3.48
75th percentile	$4.50	$4.25	$4.20	$4.00	$4.25
Maximum bid	$7.00	$8.00	$8.00	$8.00	$8.00

* Each participant bid twice, so there were 402 × 2 bids.

Table 4
Unadjusted and multivariate random effects regression models, predictors and correlates of bids for cigarette packages ($N = 402$).

	Characteristics	Unadjusted model[a]	Multivariate model
Experimental condition	Intercept (i.e., control text only)	3.59** (0.10)	4.18** (0.29)
	Large text vs. control	−0.07 (0.10)	−0.09 (0.10)
	Large text and picture vs. control	−0.55** (0.10)	−0.61** (0.10)
	Large text, picture and plain packaging vs. control	−0.85** (0.13)	−0.92** (0.13)
Age		−0.02** (0.00)	−0.02** (0.00)
Female		−0.21 (0.15)	−0.21 (0.15)
Race/ethnicity	Black vs. white	−0.06 (0.16)	0.10 (0.16)
	Other vs. white	−0.51 (0.32)	−0.55 (0.32)
Annual household income	$15,000–$35,000 vs. < $15,000	0.10 (0.17)	0.10 (0.17)
	More than $35,000 vs.<$15,000	0.00 (0.20)	0.08 (0.21)
Educational attainment	Less than HS vs. college+	0.17 (0.22)	0.16 (0.24)
	HS degree but no college vs. college+	0.08 (0.16)	0.05 (0.17)
# of cigarettes per day		0.01* (0.01)	0.01* (0.01)
Intend to quit within the next six months		−0.13 (0.15)	−0.13 (0.15)

* $p < 0.05$.
** $p < 0.01$.
[a] To assess the "unadjusted" association, a single model was run with treatment conditions dummy coded and current US warning label as the referent group. The value for the intercept reflects this model. Coefficients for the other variable in the column for bi-variate results reflect their main effects on bids, controlling for experimental condition.

and multi-variate models (Table 4). Among the demographic and smoking-related variables assessed, only age and number of cigarettes per day had a statistically significant influence on bids. In models that controlled for experimental condition, younger age and greater number of cigarettes smoked per day were associated with higher bids in general. None of the interactions between experimental condition and sociodemographic or smoking-related variables were statistically significant. Sensitivity analyses involving regression of only the first bids on experimental conditions and other study variables produced consistent results. In an alternative set of models, the branded package with the pictorial HWL was specified as the reference group, in order to determine whether the bids for the plain, unbranded pack with the same pictorial HWL were significantly lower. Results from both bivariate ($B = −0.30$, SE = 0.11, $p < 0.01$) and multivariate models ($B = −0.31$, SE = 0.13, $p < 0.01$) indicate statistically significant, lower bids for the plain, unbranded pack. These results are not included in this paper but are available from the authors upon request.

4. Discussion

Results from our study are consistent with other research that indicates the greater impact of prominent health warning labels (HWLs) with pictorial images that graphically portray the consequences of smoking, as compared to HWLs with only text [5–13]. Further, the bids for the plain labeled cigarettes with pictorial images were less than all other packages, including the HWL with pictorial images alone.

We found a minimal, non-statistically significant decrease of 2% in average bids for the package with a much more prominent, text-only HWL label than the current US label, which suggests that the inclusion of pictures may be necessary to produce a decline in demand for cigarettes. Surveys of adult smokers provide some evidence that increasing the prominence of HWLs with only text promotes thoughts about quitting, although the inclusion of pictorial elements appears to have a greater cognitive impact [7,10]. Overall, these results suggest that current FDA regulations that include pictorial elements are more likely than text-only HWLs to reduce demand. Furthermore, recent FCTC guidelines for implementing Article 11 appropriately strengthened the original FCTC language that recommended the use of pictorial elements [45]. Nevertheless, to be more effective than text, pictorials may need to show human suffering and concrete impacts of smoking [13].

This study found no evidence that the pictorial HWLs, with or without plain packaging, functioned differently across demographic groups. This is in distinction to other research indicating the potentially greater impact of pictorial imagery among people with lower levels of educational attainment [13]. Nevertheless, our sample may have been underpowered to detect such effects. Even if pictorial HWLs work equally well among smokers who have different

levels of educational attainment, this intervention should not exacerbate smoking-related health disparities, which are currently concentrated among groups with the lowest educational attainment. In our study, we only addressed one message and one pictorial element, and it may be that other messaging strategies work better with groups with lower educational attainment, including more personalized, testimonial-style imagery [20]. More experimental research is needed to further delineate which particular warning labels work best. Smoking disparities may be more adequately reduced if pictorial warnings are developed to resonate with the population segments that have the highest rates of smoking.

Many health policy researchers and tobacco control advocates are calling for "plain" packages, which would eliminate color and brand imagery [23,24] because this imagery can support false beliefs about the reduced risks of some brand varieties and it can increase the salience and believability of pictorial warning labels [25]. Our results are consistent with this research, indicating that plain packaging further reduces demand for cigarettes above and beyond the impact of pictorial health warnings. As we hypothesized, the lowest demand was for cigarette packs that had no brand imagery aside from the brand name font and descriptor, whose bids were 17% lower than the bids for the package with the current US warning label. The importance of tobacco packaging as a marketing vehicle only grows as countries ban marketing through other channels. Standardized, plain packaging without colors, numerical descriptors or brand imagery reduces false beliefs about relative product risk [26], increases the noticeability, recall and believability of health warnings [29,30] and reduces brand appeal among both adults [31] and youth [32–34]. No country has implemented "plain" packaging regulations; however, the UK government is actively consulting on plain packaging regulations [46], Uruguay has limited the number of brand varieties to one type per brand, and Australia has announced that it will implement plain packaging in July 2012. In order to remove misleading information from cigarette packages, other countries will have to consider implementing plain packaging.

5. Limitations

Although auction studies are "demand revealing" in principle, experimental conditions do not exactly correspond to "real" market transactions. Participants may have ascribed lesser value to the cigarette pack with the pictorial image due to demand characteristics or socially desirable responding. However, bids for the larger, text-only warning label were no different from bids for the control condition pack, suggesting that the pictorial element, and not the experimental context, accounts for the results. Future research might reduce the possible influence of demand characteristics by situating cigarette packs among other products on which participants bid, so that the pack does not stand out as much. Also, it could be important to assess impact of new HWLs independent after the novelty effect wears off. One means of doing so would be to invite participants back at a later date for a second round of bidding.

Another limitation concerns how the HWLs and brand elements were combined across conditions. The branded Marlboro packages that contained the front-of-package textual or grotesque imagery HWLs showed the distinctive Marlboro chevron and associated colors, but the brand name appeared only on the top and bottom of the pack, not the front and back (see Fig. 1). For these conditions, the Newport packages showed the brand name, since it is located in the upper right of the pack. Also, our "plain" or unbranded packaging condition involved removal of brand symbols and colors, but did retain the font style used by those particular brands. Different labeling policies, such as an unbranded package that does not retain the font style of companies, as well as industry responses to these policies, may lead to different outcomes than those we found here.

This study was conducted with a convenience sample of smokers and so the results may not generalize to the US population of smokers. However, the sample was recruited in four states with different levels of tobacco control and involved intercept-type surveys that resulted in recruiting a substantial proportion of minority smokers and smokers with lower educational attainment and income; hence, the results likely generalize to a broader population than many convenience samples. The difficulty of coordinating the logistics for randomly selected smokers may make such a strategy impractical for future research, especially given the relatively short period of time that participation takes.

One final limitation is that our experimental auction can only capture a short-term impact among smokers. The grotesque labels may have a different impact in the longer term and we are unable to capture this impact. Further, graphic labels may impact non-smokers, yet an experimental auction with smokers will not be able to capture this effect. In spite of these potential issues, the auction method may better simulate market transactions than hypothetical economic scenarios [42], including presumed proxies for downstream behavior, such as self-reported cognitive impact or behavioral intention. Indeed, a clear strength of this method is its focus on a behavioral outcome. Furthermore, the use of bids that involve monetary units to estimate demand introduces more variation in possible responses than traditional response formats for self-reported cognitive impact allow (e.g., 5-point Likert scale), and, hence, may provide a more sensitive and discriminating indicator of impact.

6. Conclusions

Results from our study suggest that prominent health warnings with graphic pictures will reduce demand for cigarettes. Pictorial warnings on plain packaging produced the greatest decrease in demand. Regulators should consider the use of pictorial imagery on HWLs, as well as plain packaging, in order to reduce demand for tobacco products.

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