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Communicating about Chemicals in Cigarette Smoke: Impact on Knowledge and Misunderstanding

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Abstract

Background.—The US must publicly share information about harmful and potentially harmful constituents (chemicals) in tobacco products. We sought to understand whether webpages with chemical information are "understandable and not misleading to a lay person."

Methods.—Participants were a national probability sample of US adults and adolescents (n=1,441, 18% smokers). In an online experiment, we randomly assigned participants to view one of the developed webpages (chemical names only, names with quantity ranges, names with visual risk indicators) or no webpage in phase one (between-subjects). Participants completed a survey assessing knowledge, misunderstanding, perceived likelihood, perceived severity of health effects from smoking, and quit intentions (smokers only). In phase two (within-subjects), participants viewed all three webpage formats and reported webpage perceptions (clarity, usability, usefulness) and perceived impact (affect, elaboration, perceived effectiveness).

Results.—In phase one, viewing any webpage led to more knowledge of chemicals (48%-54% vs 28% no webpage, ps<.001) and health harms (77% vs 67% no webpage, ps<.001). When exposed to any webpage, 5% to 23% endorsed misunderstandings that some cigarettes are safer than others. Webpage format did not affect knowledge or reduce misunderstandings. Viewing any webpage led to higher perceived likelihood of experiencing health effects from smoking (p<.001) and, among smokers, greater intentions to quit smoking (p=.04). In phase two, where participants viewed all formats, a visual risk indicator led to the highest perceived impact.

Conclusions.—Knowledge of chemicals and health effects can increase after viewing a website. Yet, websites may not correct the misunderstanding that some cigarettes are safer.

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Introduction

Tobacco use is the leading cause of preventable death in the United States (US), primarily due to health problems from exposure to toxic constituents (chemicals) in tobacco products and smoke.[1–4] The US public has little understanding of what these constituents are, how exposure to them occurs, and what health harms they cause.[5] As part of the Family Smoking Prevention and Tobacco Control Act, the US Food and Drug Administration (FDA) must place on "public display" information about harmful and potentially harmful constituents in tobacco products and tobacco smoke. The display must be "understandable and not misleading to a lay person." The underlying purpose of the Act is to reduce the death and disability from smoking. The FDA also has a mandate to increase understanding of the risks of tobacco use. Additionally, globally, the 181 parties to the WHO Framework Convention on Tobacco Control are required to "adopt and implement effective measures for public disclosure of information about the toxic constituents of the tobacco products and the emissions that they may produce."[6] Thus, guidance is needed for how displays can clearly communicate about chemicals to educate the public and discourage tobacco use.

Clearly conveying information about chemicals in cigarette smoke to the public is challenging. Long lists of unfamiliar chemicals and their quantities are likely to confuse the public.[5,7–9] Worse, presenting numerical information on chemical levels, as previously done with tar and nicotine yield and harmful or potentially harmful chemicals, may be counterproductive, giving the false impression that products with lower quantities are substantially safer.[8,10–12] Additionally, the chemical information must also be widely accessible to the public to have an impact, including to vulnerable populations who may struggle to make sense of and apply health information (e.g., low health literacy) or numbers (e.g., low numeracy).[13,14] Empirical data on how best to implement constituent disclosures so that they increase knowledge and do not mislead the public, especially vulnerable populations, is critical.[11,15]

Websites are one potential way to display chemical information for cigarette smoke in a user-friendly and flexible format. With the ubiquity of computers, tablets, and smartphones, the Internet is widely used in the US.[16,17] Websites are inherently flexible in that information can be divided among pages, hyperlinked, and expanded or collapsed. Using print or broadcast media to disseminate information about chemical in cigarette smoke for hundreds of brands and subbrands sold in the U.S. would be overwhelming and potentially infeasible. Although cigarette packaging and package inserts provide space for brand-specific chemical information to educate consumers,[18] growing evidence demonstrates these displays also lead consumers to believe some cigarettes are less harmful than others[8,10,12] and exposure may be limited to smokers only.[19] We hypothesized that presenting chemicals on a webpage (vs. not presenting chemicals) can appropriately inform viewers (Hypothesis 1; H1). Specifically, we predicted that showing webpages (vs. not) would increase knowledge and risk perceptions. We also examined whether presenting chemicals on a webpage would foster incorrect beliefs that some cigarettes are safer than others.

Evidence-based health communication strategies for how chemical information should be displayed are needed to maximize the usability of the information, such as by increasing

clarity, providing evaluative meaning, and drawing attention to important information.[20] Limited research has indicated that displaying *ranges* of constituent amounts (e.g., 8-16ng) rather than point estimates (e.g., 12ng) may increase knowledge without being misunderstood, by reducing the likelihood that consumers will make unfounded or scientifically inaccurate comparisons.[21] Supplementing numbers with descriptive text or entirely replacing numeric information with text can increase comprehension.[19,22,23] Moreover, evaluative meaning (whether a constituent amount is safe or harmful) can be conveyed via a visual *risk indicator* that illustrates levels of harm with color coding, potentially increasing the likelihood consumers attend to this critical information in complex displays.[24,25] We hypothesized that displaying a risk indicator would increase intended webpage reactions compared to displaying chemical quantities as ranges or names only (Hypothesis 2; H2). Specifically, we predicted that displaying a risk indicator (vs. quantities as ranges or names only) would increase negative affect, cognitive elaboration, perceived usefulness, perceived usability, and perceived effectiveness of the webpage.

Methods

Participants

For a previous study, the Carolina Survey Research Laboratory (CSRL) recruited a cohort[9,26] of US adults and adolescents (n = 5,014) from September 2014 to May 2015. CSRL selected participants using random-digital-dialing and list-assisted sampling frames, including homes with landlines and cellphones and oversampling counties with higher prevalence of smokers and low-income individuals (response rate 42%). To be eligible, participants had to be ages 13 or older and speak English. For the current study, CSRL contacted randomly selected members of the cohort in June and July 2016 (n = 1,441, response rate 82%). Participants received $45 for this second study. The Institutional Review Board at the University of North Carolina approved the study.

Procedures

Stimuli.—We designed static mock-up webpages to display information on chemicals in a fictitious brand of cigarettes (Figure 1). Each webpage had a title, the chemicals and their health effects (which differed by condition with absence or presence of ranges and of a visual risk indicator), and a footnote with information. We used 20 chemicals from the FDA's longer list of over 90 harmful and potentially harmful chemicals. We presented five categories of health effects associated with the chemicals from the FDA: cancers, permanent breathing problems, heart attack and stroke, reproductive organ damage, and addiction. The health effect category descriptions also included exemplar diseases. For the sake of generalizability, we used two different webpage layouts:[20] Layout A – health effects near the top of the webpage with the chemicals listed underneath – and Layout B – chemicals grouped by their associated health effects. In each layout, we created three different webpages with the chemical *names only* displayed, the *ranges* of the amount the chemical given with the name, and a *visual risk indicator* alongside the chemical name. The visual risk indicator was a colored dot indicating one of three levels of harm based on the quantity of the chemical, with a key given in the webpage footnote: green for "Safe: does not cause

health problems," light red for "Risky: puts you at risk to develop health problems," and dark red for "Dangerous: can cause immediate damage to your body."

Experiment.—We used a two-phase design to examine the influence of the chemical displays (Figure 2). In the first phase, we tested H1 (presenting chemicals on webpages vs. not would appropriately inform the public) in a between-subjects experiment. In it, we randomly assigned participants to view one of the developed webpages with chemical information (chemical names only, names with quantity ranges, names with visual risk indicators) or no webpage.

In the second phase, we tested H2 (displaying a visual risk indicator vs. not would increase intended webpage reactions) in a within-subjects experiment. In it, we randomly assigned participants to view webpages with chemical *names only*, quantities shown as *ranges*, or a *visual risk indicator* without quantity information. Participants who saw a webpage in phase one continued to answer questions about that webpage before viewing the two other formats, in a random order. We randomly assigned participants in the no-webpage control to one of the three within-subjects conditions – name only, ranges, or a visual risk indicator – before viewing the two other formats. Participants viewed each of the three webpage formats in a random order.

Measures

Between-Subjects Outcomes (H1).—In phase one, the survey assessed knowledge of harmful chemicals (both familiar and unfamiliar) in cigarette smoke,[11] knowledge of health effects, perceived likelihood of harm,[27] and perceived severity of harm among all people and misunderstanding among participants who viewed a website. The survey assessed knowledge of five harmful chemicals in cigarette smoke (acrylonitrile, ammonia, isoprene, lead, 1-aminoaphthalene) and five health effects caused by smoking (cancer of the pancreas, blood clots, erectile dysfunction, lung damage, addiction). We coded correct responses as 1 and incorrect or don't know responses as 0; we then averaged the variables to create chemicals and health effects knowledge scores that ranged from 0% to 100%. The survey assessed misunderstanding for participants exposed to a website with items concerning beliefs that the fictitious brand is "safer to smoke," has "fewer harmful chemicals," is "much more harmful," or "much less harmful" than other cigarettes.[11] We designated responses of "somewhat agree" or strongly agree" as a misunderstanding (scored as 1; otherwise 0) and then averaged the variables to create a misunderstanding score that ranged from 0% to 100%. The survey assessed misunderstanding specific to one's current cigarette brand and quit intentions[28] (smokers only). Appendix A provides additional details on the outcome measures.

Within-Subjects Outcomes (H2).—For all three webpages viewed in phase two, the survey assessed negative affective reactions to the website,[29] cognitive elaboration (the website made participants think about the harms of smoking),[27,30] perceived usefulness,[20] perceived usability,[20] webpage clarity for the chemical amount present and harmfulness of the amount,[20] and perceived effectiveness (discourage smoking)[31] for all participants. The

survey also assessed perceived effectiveness of the webpage to encourage quitting (smokers only).

Covariates.—Two standard items assessed smoking status.[32] We defined smokers as people who had smoked at least 100 cigarettes in their lifetime and currently smoke every day or some days. Health literacy was assessed with passage B, a reading comprehension portion, from the Short Test of Functional Health Literacy.[33] Passage B uses a modified cloze procedure that omits every fifth to seventh word of sentences written at a 10th grade reading level. Participants selected the correct word to complete the sentence from four options. Due to few participants with low scores (see Table 1), we divided health literacy between those with perfect scores (20 correct) and those that missed one or more items (0-19 correct). Lastly, the survey assessed objective numeracy with three standard items from Schwartz et al.[34] and another item requiring participants to select the biggest risk shown in numbers.[35] We coded numeracy items as correct (1) or incorrect (0; missing responses were coded as incorrect) and averaged them for a total numeracy score.

Data Analysis

To determine the impact of a webpage about chemicals (phase one), we conducted a multivariate analysis of variance (MANOVA) to correct for multiple tests. Predictor variables were webpage (treatment) vs. no webpage (control); no differences existed for the blocking variable – webpage layout – so we combined the groups for the between-subjects analyses. Outcome variables included knowledge of chemicals and health harms (overall and by item), as well as perceived likelihood and severity of health effects from smoking. We conducted a separate MANOVA to analyze misunderstanding (overall and by item) about the fictional brand among those who viewed any webpage and an ANOVA to analyze the impact of a webpage (vs. no webpage) on quit intentions for smokers only. We then conducted exploratory MANOVAs for possible moderation of each covariate on all outcomes. For all statistically significant MANOVAs (p<.05), we conducted ANOVAs for each outcome and pairwise comparisons with Bonferroni corrections (health literacy and numeracy) or in a planned comparison (age).

To investigate the impact of the format of chemical information (phase two), we conducted MANOVAs with format type (chemical name only vs. with ranges vs. with a risk indicator) as a predictor. Outcome variables included webpage perceptions (clarity, usability, usefulness) and perceived impact (affect, elaboration, perceived effectiveness). We then conducted separate ANOVAs to analyze the impact of a webpage format on perceived effectiveness for quitting for smokers only. We conducted exploratory MANOVAs for possible moderation of each covariate on all perception outcomes. For within-subject analyses, we conducted repeated-measure ANOVAs for significant MANOVAs, using Geenhouse-Geisser adjusted F-tests to correct for violations of sphericity.

Results

Participants' mean age was 32 (range 13-90, Table 1). Participants were White (76%), non-Hispanic (94%) and did not have a college degree (69%). Eighteen percent were current smokers. Most missed one or more health literacy (61%) or numeracy items (75%).

Impact of Webpage (Between-Subjects Analysis)

Participants who viewed a webpage about chemicals had higher overall knowledge of chemicals and health effects than those who did not see a webpage (Table 2), regardless of the webpage layout. Participants who saw a webpage (vs. not) had greater knowledge of chemicals overall (48-54% vs. 28%, *p*s<.001), including familiar chemicals, such as ammonia, and unfamiliar chemicals, such as acrylonitrile. Participants who saw a webpage (vs. not) had greater knowledge of health effects overall (77% vs. 67%, *ps*<.001). The webpage increased knowledge of cancer of the pancreas, blood clots, erectile dysfunction, and addiction but not lung damage. Among participants who viewed the webpage, 5% to 23% had misunderstood the fictional cigarette brand shown on the webpages to be safer than other cigarettes; among smokers, 18% to 22% misunderstood the fictional brand to be safer than their brand. Layout A (health effects at the top) led to higher knowledge of chemicals than layout B; there were no other main effects or interactions for layout or chemical format in phase one.

Participants who viewed a webpage (vs. not) also perceived a greater likelihood of experiencing health effects caused by smoking regularly ($p < .001$), but they did not perceive greater severity of these health effects. Notably, smokers who saw a webpage about chemicals had greater quit intentions compared to those who did not see a webpage ($p = .044$).

Smoking status, health literacy, and age did not moderate the impact of the webpage for any outcome (for descriptive purposes, Appendix B provides outcomes by age). The impact of the webpage on perceived severity was greater among participants who incorrectly answered all numeracy items versus those who correctly answered one or more numeracy items (p interaction < .001), a finding that may be due to only 64 participants (4%) who incorrectly answered all numeracy items.

Impact of Format (Within-Subjects Analysis)

Webpages with the risk indicator elicited higher perceptions of usable information – through perceived usefulness of the webpage, perceived usability, perceived clarity of the amount of each chemical (amount present), and whether each chemical amount is harmful (harmfulness of amount) (*p*s < .001, Table 3). The one exception was that webpages with risk indicators or ranges did not differ on the perceived clarity of the chemical amount. The risk indicator also elicited more negative affect toward smoking and greater cognitive elaboration about the harms of smoking (*p*s < .001). Webpages with a risk indicator ($M = 4.53$, $SD = .77$) or ranges ($M = 4.35$, $SD = .86$) elicited higher perceived effectiveness for discouraging smoking among all participants compared to webpage with chemical names only ($M = 4.28$, $SD = .90$). Furthermore, for smokers, the perceived effectiveness for increasing the likelihood of quitting was higher for webpages with the visual risk indicator ($M = 3.77$, $SD = .83$) or ranges ($M = 3.61$, $SD = .88$) names only ($M = 3.51$, $SD = .89$).

To ensure repeated exposure to websites did not change our findings, we conducted exploratory analyses of only the first website viewed. The findings for format remained in all but one case. The one exception was that the formats did not differ with respect to

cognitive elaboration. Additional exploratory analyses found that condition assignment from phase one did not moderate the impact of format for any outcome.

Discussion

Websites are one potential way to educate the public about chemicals in cigarette smoke to potentially discourage tobacco use.[11,20] Given the public's low understanding of cigarette-smoke chemicals, a website with chemical names, added ranges, or an added visual risk indicator could inform adolescents and adult consumers about unfamiliar chemicals[11,23] and less widely known harms (e.g., reproductive organ damage).[36] For example, the websites' higher impact on knowledge of unfamiliar chemicals (20-31% for acrylonitrile, isoprene, 1-aminoaphthalene) compared to familiar chemicals (14-23% for ammonia, lead) provides promise that chemical disclosures could address low awareness in the US.[37] Websites may also increase the perceived risks of smoking. Smokers who viewed the webpage were more likely to intend to quit smoking.

Our findings provide some guidance for how to present chemical information. Visual risk indicators best communicated meaning by color-coding the level of harm. Exposure to a single webpage increased knowledge regardless of format, but exposure to multiple webpage formats elicited evaluations that varied by format. When shown three formats, we found providing a visual risk indicator led to greater negative feelings about cigarettes, thinking about harms, perceived effectiveness for discouraging smoking, and among smokers, encouraging quitting more than showing names only or amounts (as numerical ranges). Contextualizing chemicals with risk indicators also led to the highest usability, usefulness, and clarity of information, likely from viewers' ability to quickly understand the meaning of the complex information.[20,38] Visual risk indicators may encourage affective and cognitive reactions to motivate action (e.g., website use) necessary for public education.[39] According to the evaluability hypothesis,[40] joint (within-subjects) evaluations often better mirror real-world behavior and decisions context (e.g., visiting several websites to compare health information).[41,42] These comparisons allow individuals to assess hard-to-evaluate attributes more easily (e.g., individuals do not have prior experience with or comparable references for chemical disclosures). As a result, comparisons may more accurately characterize public perceptions.

Despite the benefits of displaying chemical information in a website, some people had misunderstandings after viewing a cigarette brand chemical list. Almost one in ten people thought (incorrectly) that an unspecified amount of fewer harmful chemicals indicated meaningfully lower risk, even though research has not demonstrated meaningful differences in harmfulness across brands.[43] One-fifth of smokers reported that seeing a high level of a harmful chemical in their brand would encourage them to switch to a different brand. This is roughly the same number of smokers who endorse the misunderstanding that some brands are less harmful than others[44] even though brand switching does not significantly reduce carcinogen exposure.[45] Incorrectly believing one has the ability to switch to less harmful brands may reduce intentions to quit smoking[46] and undermine tobacco control efforts. Possible benefits of a chemical quantity disclosures for encouraging quitting may be negated if people use the website to shop for "safer" brands of cigarettes. These findings support

other data that people are misled, sometimes greatly, by chemical information[11,47] and websites are unlikely to undo the misunderstanding that some cigarettes are safer. Given these competing benefits and unintended reactions, displays of chemical information that allow for brand comparisons may be problematic.

Because websites require active information seeking from people, public access may remain limited. To maximize reach, warnings, package inserts, and other campaign materials could include website links. Alternative solutions, such as designing warnings or campaigns to highlight the presence of chemicals across brands, may be a more effective way to demonstrate risk, educate the public, and discourage use. However, some disclaimers have only limited effectiveness.[48] Future research is needed to explore novel ways of conveying the harm from the chemicals in cigarettes without perpetuating misunderstandings.

Study strengths include the large national sample and experimental design. Study limitations include that only participants who viewed a webpage responded to questions about being misled; future studies should assess the prevalence of misunderstandings more broadly. Additionally, we manipulated a limited set of webpages based on our previous research for designs that are clear and usable.[20] Other webpage variations, including a full list of FDA's harmful and potential harmful chemicals, providing chemical information for multiple brands, and leveraging website affordances (e.g., links, interactivity) could have greater effects or fewer unintended consequences. Third, our website variations prominently featured the text, "Smoking cigarettes puts toxic and deadly chemicals in your body;" we did not include any explicit statements to reduce specific mischaracterization of the information that may influence brand switching (e.g., no cigarette brand is safer than others). Participants previously took a survey about many tobacco communication issues, including chemical information. The previous study was conducted over a year before this study (September 2014-May 2015) but that participation may have influenced our findings. Because few of our participants had low health literacy, replicating our findings with a larger lower-literacy cohort could clarify the generalizability to this important population. Last, international studies can confirm whether chemical disclosures following the Framework Convention on Tobacco Control requirements inform the public and discourage smoking.

Conclusion

Communicating about chemicals in cigarette smoke through a website can inform the public, but some consumers are likely to still have misunderstandings. In our study with US adults and adolescents, viewing any of the websites led to greater knowledge of chemicals and their associated health effects, higher perceived likelihood of harms associated with smoking, and among smokers, greater quit intentions. Websites with chemical amounts displayed with visual risk indicators were perceived as more clear, usable, and useful, and they led to greater negative feelings and more thinking about harms. Yet, after viewing the website, adults and adolescents reported that brands having fewer or small amounts of harmful chemicals meant meaningfully lower risk, and one of five smokers reported they might switch brands if their brand had a high level of a harmful chemical. Although chemical information about toxins in cigarettes can be clearly displayed to inform US consumers,

some members of the public may use this information to reinforce and act on incorrect beliefs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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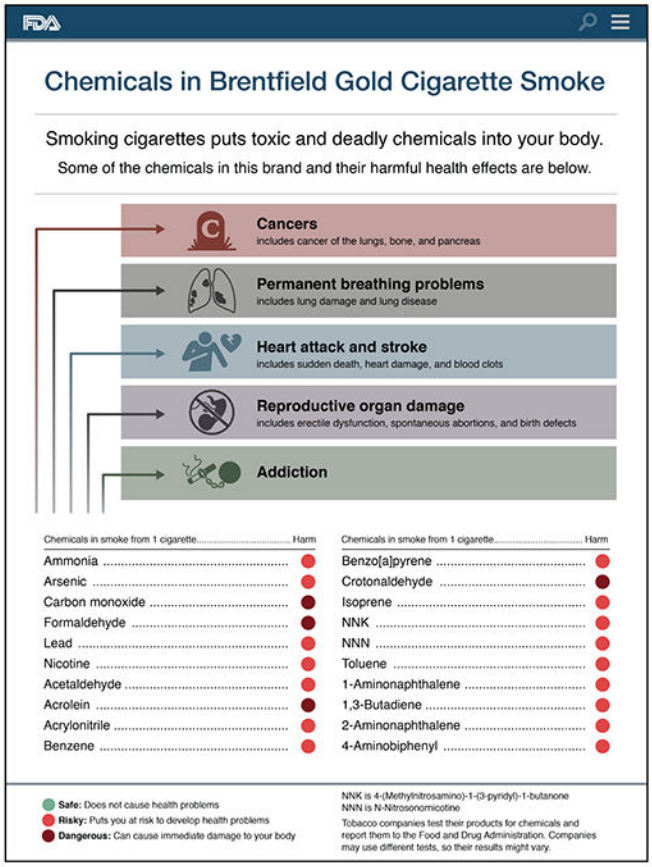
What this study adds:

- Websites with chemicals names, or with the addition of numerical ranges or a visual risk indicator, can educate the public about toxic chemicals in cigarette smoke and their health effects and, among smokers, any website exposure led to higher quit intentions.
- Despite this promise, websites may not correct the misunderstanding that some cigarettes are safer, and smokers may use chemical information to seek out less harmful cigarette brands.

Layout A,
Format: Chemicals shown with a visual risk indicator



Layout B,
Format: Chemicals shown with ranges

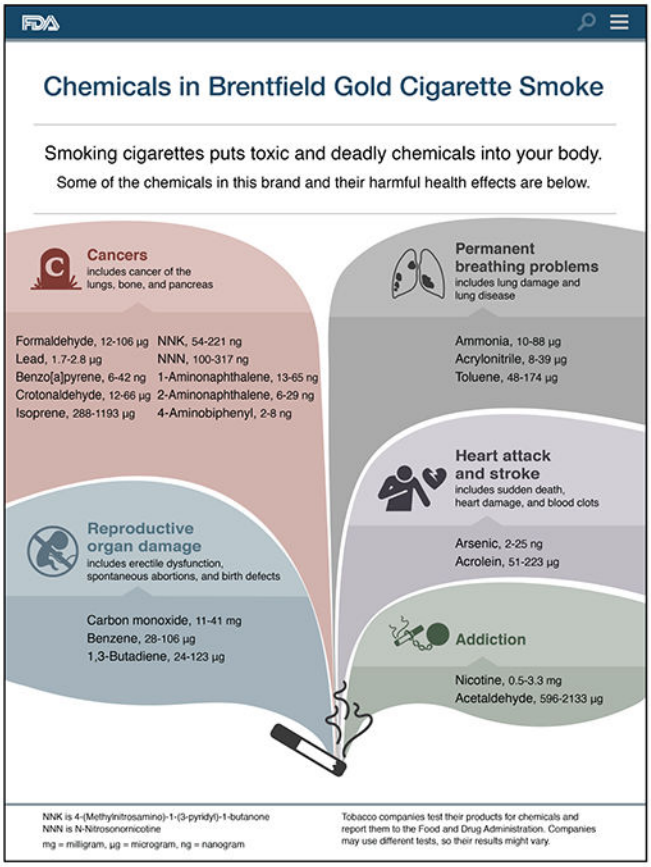


Figure 1.
Example webpages for communicating about chemicals in cigarette smoke.

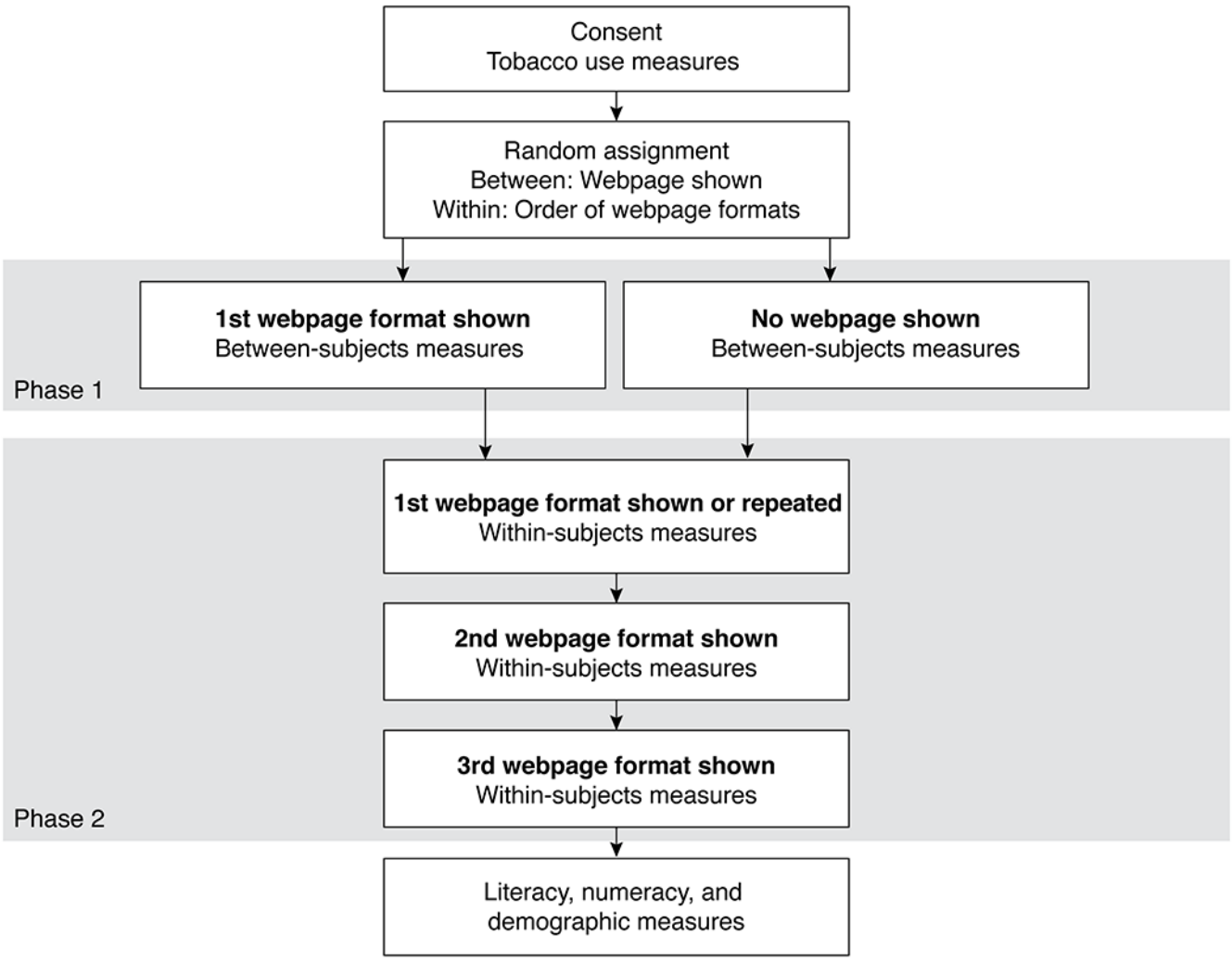


Figure 2.
Experimental design.

Table 1.

Participant Demographics (n = 1441)

	***n* (%)**
Age (M = 32.47, SD = 18.69)	
Adolescents (13-17)	427 (30%)
Young adults (18-25)	320 (22%)
Adults (26 or older)	692 (48%)
Gender	
Female	776 (54%)
Male	654 (45%)
Transgender/Other	10 (1%)
Race	
White	1095 (76%)
Black or African American	218 (15%)
American Indian or Alaska Native	22 (2%)
Asian	36 (3%)
Pacific Islander	8 (1%)
Other	61 (4%)
Ethnicity	
Non-Hispanic	1347 (94%)
Hispanic	94 (7%)
Education	
Less than high school	462 (32%)
High school diploma	253 (18%)
Some college	273 (19%)
Associate’s degree	94 (7%)
Bachelor’s degree	222 (15%)
Graduate or professional degree	135 (9%)
Smoking status	
Smoker	262 (18%)
Nonsmoker	1179 (82%)
Health literacy	
Missed four or more (0-16)	85 (6%)
Missed three (17)	73 (5%)
Missed two (18)	181 (13%)
Missed one (19)	542 (38%)
Perfect score (20)	560 (39%)
Numeracy (4 items)	
Missed four (0)	64 (4%)

	***n* (%)**
Missed three (.25)	197 (14%)
Missed two (.5)	377 (26%)
Missed one (.75)	448 (31%)
Perfect score (1)	355 (25%)

Table 2.

Knowledge, Misunderstanding, and Risk Perceptions for a Webpage about Chemicals in Cigarette Smoke

	1. Control, No Webpage (*n*=483) *M (SD)*	2. Webpage Shown, Layout A (*n*=486) *M (SD)*	3. Webpage Shown, Layout B (*n*=472) *M (SD)*	*F*	1-2	1-3	2-3
Knowledge of Chemicals	28% (.33)	54% (.34)	48% (.35)	79***	***	***	*
Acrylonitrile	19% (.39)	47% (.50)	45% (.50)	53***	***	***	
Ammonia	51% (.50)	73% (.45)	63% (.48)	27***	***	***	**
Isoprene	17% (.38)	43% (.50)	38% (.49)	43***	***	***	
Lead	32% (.47)	55% (.50)	46% (.50)	26***	***	***	*
1-aminoaphthalene	21% (.41)	52% (.50)	50% (.50)	66***	***	***	
Knowledge of Health Effects	67% (.24)	77% (.22)	77% (.22)	30***	***	***	
Cancer of the Pancreas	48% (.50)	67% (.47)	67% (.47)	25***	***	***	
Blood Clots	59% (.49)	65% (.48)	68% (.47)	3*		*	
Erectile Dysfunction	33% (.47)	55% (.50)	52% (.50)	29***	***	***	
Lung Damage	98% (.14)	99% (.11)	98% (.13)	<1			
Addiction	96% (.20)	99% (.11)	97% (.16)	3*	*		
Misunderstanding of Brand Shown Compared to Other Cigarettes	n.a.	8% (.16)	9% (.16)	2	n.a .	n.a.	
Safer to Smoke		5% (.21)	6% (.24)	<1			
Fewer harmful chemicals		9% (.28)	8% (.28)	<1			
Much more harmful		16% (.40)	23% (.42)	5.90*			*
Much less harmful		7% (.26)	7% (.26)	<1			
Misunderstanding of Brand Shown Compared to Smoker's Brand *Smokers only, n=174*	n.a.	20% (.38)	19% (.37)	<1	n.a .	n.a.	
Safer to Smoke		22% (.41)	19% (.39)	<1			
Fewer harmful chemicals		18% (.39)	19% (.39)	<1			
Perceived Likelihood	3.77 (.68)	3.97 (.64)	3.92 (.69)	11***	***	**	
Perceived Severity	3.70 (.50)	3.73 (.49)	3.72 (.51)	<1			
Quit Intentions *Smokers only, n=262*	4.30 (1.99)	4.65 (1.79)	5.02 (1.72)	3*		*	

Note. n.a. = not applicable; the survey assessed misunderstanding only for participants who viewed a webpage.

* $p < .05$;

** $p < .01$;

*** $p < .001$

Table 3.

Affective and Cognitive Responses to Chemical Displays on Webpages about Chemicals in Cigarette Smoke (n = 1424)

	1. Chemical name only *M (SD)*	2. Chemical with ranges *M (SD)*	3. Chemical with a risk indicator *M (SD)*	*F*	1-2	1-3	2-3
Perceived Usefulness	3.46 (1.35)	3.74 (1.24)	4.19 (1.02)	219***	***	***	***
Perceived Usability	3.94 (1.12)	3.71 (1.26)	4.33 (.95)	180***	***	***	***
Webpage Clarity (Amount Present)	2.78 (1.52)	3.47 (1.40)	3.53 (1.44)	185***	***	***	
Webpage Clarity (Harmfulness of Amount)	2.73 (1.54)	3.08 (1.49)	4.02 (1.25)	495***	***	***	***
Affect	−1.89 (1.40)	−2.02 (1.35)	−2.25 (1.28)	61***	**	***	***
Cognitive Elaboration	3.81 (1.11)	3.95 (1.04)	4.21 (.96)	154***	***	***	***
Perceived Effectiveness (Discourage Smoking)	4.28 (.90)	4.35 (.86)	4.53 (.77)	87***	**	***	***
Perceived Effectiveness (Quitting) *Smokers only, n=261*	3.51 (.89)	3.63 (.88)	3.77 (.83)	17***	*	***	**

* $p < .05$;

** $p < .01$;

*** $p < .001$