HHS Public Access

Author manuscript

Tob Regul Sci. Author manuscript; available in PMC 2024 August 27.

Published in final edited form as:

Tob Regul Sci. 2018 November ; 4(6): 18–37. doi:10.18001/trs.4.6.3.

Does Visual Attention to Graphic Warning Labels on Cigarette Packs Predict Key Outcomes Among Youth and Low-income Smokers?

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Abstract

Objectives: This study examined whether patterns of visual attention to graphic warning labels on images of cigarette packs predict key outcomes associated with warning label effectiveness.

Methods: A mobile lab with 5 eye-tracking stations travelled to socioeconomically disadvantaged communities to recruit biologically confirmed adult smokers (Study 1: N = 725) and middle school youth (Study 2: N = 767). We examined patterns of association between eye-tracking measures and negative emotional responses, health risk beliefs, intentions to quit smoking (Study 1), and susceptibility to smoke in the future (Study 2).

Results: In both studies, participants attended to warnings over branded content. Within the warning area, images attracted attention for longer than text. Findings differed between studies in how attention to content features predicted discrete emotions. Youth who gazed longer at the images in warnings reported lower susceptibility to future smoking.

Conclusions: Images function as an important addition to text warnings, partly because they divert attention from branded content. Fixation on images associate with key outcomes, including negative affect and, for youth only, susceptibility to smoking.

Keywords

Graphic warning labels; tobacco; FDA; eye tracking; message impact framework

The field of tobacco regulatory science has produced strong evidence that including prominent graphic warning labels (GWLs) on tobacco products is associated with a variety of outcomes linked to reduced smoking behavior.[1,2,3,4,5] Indeed, a meta-analysis of 37 experiments involving 48 different samples found that exposure to pictorial warnings were

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Conflict of Interest Statement
All authors of this article declare they have no conflicts of interest.

more effective than text only warnings on in promoting negative emotions and intentions to quit smoking.[4] Some of this work has sought to isolate the effects of specific content strategies through randomized experiments.[6,7,8] Eye-tracking studies would appear well-suited to this goal. However, the Noar et al. (2015) meta-analysis included data from only 2 studies that employed eye-tracking technology. Meernik et al. (2016) reviewed a handful of studies using eye-tracking methodology to examine warning labels in tobacco regulatory science, but most of these studies have featured relatively small sample sizes due to the resources needed to conduct such experiments. Eye tracking studies on warning labels can inform health policy as countries around the world transition to pictorial warnings. In the USA, for example, the federal government is required by the US Family Smoking Prevention and Tobacco Control Act (Tobacco Control Act) of 2009 to place graphic warning labels on cigarettes. The US Food and Drug Administration (FDA) is currently revisiting options for warning label content after the first round of proposed labels was adjudicated as unconstitutional in federal court.[9]

There is not yet clear evidence that attention to a specific area of interest (AOI) - such as image, text, or brand – predicts downstream effects of exposure such as risk beliefs, negative emotion, or intentions to quit smoking, in part due to limited statistical power. Few eye tracking studies have included socioeconomically disadvantaged smokers or at-risk youth in their samples, even though these populations smoke at a higher rate.[10] The lack of representation in research may be attributable to the fact that eye tracking studies often require participants to travel to visit a university lab space, limiting access to socioeconomically diverse populations.

The aim of the current study is to examine eye tracking patterns with a large sample of socioeconomically disadvantaged individuals who were exposed to GWLs in an experimental lab setting. We accomplish this by combining common data points across 8 eye-tracking experiments where individuals in at least one condition were exposed to GWLs based on those proposed by the U.S. Food and Drug Administration (FDA) in 2011. Our primary goal is to test whether viewing patterns predict downstream effects such as negative emotions, risk beliefs, intentions to quit smoking (adults), or susceptibility to start smoking (youth).

Attention to Warning Content and Branding Content

Much of the work focused on patterns of attention to GWLs on cigarettes relies on self-reports.[4] However, eye tracking has been used as an objective behavioral measure of attention to GWLs on cigarettes as well as cigarette advertisements.[11,12,13,14,15] Studies have found, for example, that individuals look longer at warnings with color images compared to warnings with black and white images, and show an attentional preference for pictorial warnings over text.[7,15,16]

Cigarette companies design their branding and advertising to attract attention, and decades of research supports this premise.[17] While warnings can influence key outcomes directly (eg, by increasing negative feelings about cigarette smoking), they can also function to distract attention from highly strategic and savvy tobacco messaging strategies.[18] Indeed,

warnings that are novel, graphic, and stylized appear better at distracting from tobacco branding, packaging, and advertising efforts.[13] Size also matters, with larger GWLs garner attention longer than smaller, for both youth and adults.[8] though this effect appears to diminish as the warnings become smaller in size or are placed on more distracting content, such as cigarette ads instead of packs.[12]

Eye Tracking and Associations with Downstream Outcomes

In many eye tracking studies focused on warning labels, the primary outcome of interest is recall of warning.[12,14,16] The finding that dwell time on warning information is connected to recall of the warning information has been found across varied populations, including rural adults[12] and adolescents.[14] However, few studies have looked at the relationship between attention to specific AOIs within the warning to other processing related outcomes such as negative emotion, beliefs, and intentions.[7,8,15] This is somewhat surprising because the message impact framework[4] indicates that specific warning content can attract attention and promote recall, which in turn is associated with more distal effects such as emotional reactions and intentions to quit or, among non-smoking youth, to consider starting to smoke. Indeed, scholars have argued that visual fixation directly on a specific content (like a graphic image) within a health warning is a requirement for downstream effects of exposure to that specific element in the message.[12,13,19]

Two Key Populations – Adult Smokers and Susceptible Youth

Some evidence suggests that regular smokers are more likely to avoid warnings, while those at risk of uptake (youth) might be less likely to avoid this imagery and text.[19,20,21] Adolescents and current smokers both have reasons to resist warning label information. Adolescents are known to be more developmentally reactant, whereas smokers may value their freedom to smoke.[22] Considering that the U.S. Tobacco Control Act targets both (a) promoting quitting among current smokers and (b) preventing smoking among youth at risk of uptake, studies with implications for the design and implementation of tobacco warning labels should consider their effects on these 2 very different populations. Key questions include how adult smokers (who may be struggling with nicotine dependence or other physiological, social, or cultural factors that influence their smoking behavior) and middle-school youth (who typically are not (yet) regular smokers) attend and react to warning label imagery and accompanying textual information. The current study seeks to address these questions by using a consistent methodology across 2 studies with independent samples of both adult smokers and youth from low-income communities. Specifically, we ask:

RQ1: Does attention to specific areas of interest (AOI) with GWLs—such as image, text, or brand—predict risk beliefs, negative emotion, intentions to quit smoking among socioeconomically disadvantaged adult smokers (Study 1) or susceptibility to future smoking among middle-school youth (Study 2)?

METHODS

Source of Data

We extracted data used for this analysis from a subset of specific experimental arms within 8 larger experiments examining how variations of the 2011 United States Food and Drug Administration-proposed GWLs influence visual attention (via eye tracking), emotions, risk beliefs and smoking-related intentions or susceptibility; those methodologies have been detailed elsewhere.[7]

For this analysis, data were included only from participants who were assigned to a condition requiring them to view images of cigarette packages with minimal variations on the 2011 proposed US-FDA GWLs (all labels included both image and text). We combined these data to create 2 separate data sets for the current studies, one with biochemically verified adult smokers (Study 1: N = 725) and one with middle-school youth (Study 2: N = 767). Other than emotional reactions, all other dependent variables were unique between the samples to account for differences in cognitive development, literacy ability, and qualitative differences in the desired behavior (quitting among adults vs. avoiding starting among youth). Therefore, we analyzed adult and youth samples separately. Descriptions of stimuli and sample size across the experimental variations are detailed in Table 1. We controlled for each of these experimental variations in the subsequent analyses using a series of indicator variables, as described in greater detail in the pages below.

Participants

Adult smokers.—Our adult sample of regular smokers (referred to as AS in statistical reporting below) resided in both rural and urban areas of the Northeastern United States. We identified low SES communities by a combination of analysis of median annual household income census data with attention to areas under $35K, contact with site-specific organizations that served low-SES communities, discussions with local representatives, and in-person site scouting. We visited each site only once, unless it was a large urban area, in which case up to 3 different parts of a given city served as data collection sites.

We first secured permits and necessary security in each community and, when possible, formed partnerships with local organizations. On data collection dates for adults, we arrived in city and town centers or at a host organization’s location with a fully functional mobile laboratory (the size of a small RV) equipped with 5 private experimental workstations. We placed signage around the lab, indicating that adults who were regular smokers could participate in the study for $20 cash. If we had a host, that host would let their clientele know about our presence via Facebook, fliers, and word of mouth. Data collection most often occurred between 9am and 6pm. After obtaining informed consent, we confirmed participants as regular smokers through one of 2 biochemical validation procedures: (a) a CoVita carbon monoxide detection breath test requiring at least 7 ppm (a result indicating regular smoking) or, in a handful of people with breathing problems, (b) an Alere saliva test indicating a positive rating for the presence of cotinine (a nicotine metabolite). We only allowed qualifying participants to continue.

The adult sample identified as 54% male, 11% Hispanic, and 53% as non-White (N = 249 Black; N = 163 one or more non-White, non-Black categories, or other). A majority (64%) had a total yearly household income of < $20,000/year, 69% reported their highest level of formal education being a high school diploma or less, 65% reported having utilized government food voucher services, and 51% reported being food insecure. The adult smokers in the sample ranged in age from 18–80 (M = 39.5, SD = 13.8) and 56% had made a quit attempt in the past year. The final N = 725 excluded participants (N = 127) who were removed from this analysis for various eye-tracking related issues, including tracking under 30% and calibration errors.

Middle school youth.—The youth in these studies (referred to as Y in statistical reporting) participants (N = 767) were middle school students living in both rural and urban communities in the north- eastern United States. We first identified communities via census data and contacts with partner organizations. We then reviewed publicly available data on the percentage of students who qualified for the federal free or reduced lunch program for low-income families. We completed district-level approval and permissions processes as required. Participating schools (averaging 70% free or reduced lunch) sent parents IRB-approved, opt-out consent forms in the weeks before we conducted the study, and each participant signed an assent form immediately before taking the study. Middle school students were not required to be smokers to participate, as the purpose was to study smoking uptake. Nearly half (46%) reported living with a smoker, and only 9% had tried at least a puff of a cigarette. Half (50%) of the youth respondents who provided information about sex identified as female, 47% as male, (3%) selected that they preferred not to answer or were transgender and another 11(1.4%) did not respond. Participants had a median age of 12.8 (SD = 1.0). The majority (53%) identified as non-Hispanic White, 36% Black or African American, 10% Hispanic or Latino, 22% indicated another race or ethnicity. The final N = 767 excluded participants (N = 94) who were removed from this analysis for various eye-tracking related issues, including tracking under 30% and calibration errors.

Study Procedures

We assigned all participants a unique identifying number that contained details on their random assignment to the experimental conditions, the details of which were specific to each experiment (see Table 1) but in each case had at least one condition with a GWL covering at least 30% of the front of the cigarette pack image (additional details below). We then escorted the participant into a private study station housed in the mobile laboratory and seated them for the study. Each station featured TobiiStudio eye tracking software and Tobii LCD monitors to unobtrusively collect data on the screen location of participants' eye gaze, as well as an iPad with the Qualtrics-based post-test questionnaire. Before viewing the stimuli for their randomized condition, each participant completed a -point eye-tracking calibration process. Research assistants read the study instructions to participants, while those instructions were also visible on the screen. Participants completed all calibration tasks and viewed the images assigned to their condition while seated approximately 2 feet from the computer monitor.

Immediately after viewing the stimuli according to their assigned condition, we handed respondents an iPad to answer a series of closed-ended questions gauging emotional and cognitive reactions on a Qualtrics survey application. The average participant completed the study in 25 min, not including wait time. We paid each adult participant $20 cash upon study completion. For youth, we offered 2 incentive options to accommodate district policies and requests: $10 gift cards for students or a $10 per-student payment to the school to support student initiatives. The study took, on average, 15 – 20 min to complete, and students rarely had to wait to begin the study. We debriefed all participants about the rationale for the study.

Stimuli

Each participant viewed a set of images of cigarette boxes, randomly ordered, consistent with their randomized condition. The images appeared one at a time, automatically advancing after 10 s each, for 90 s of total screen time. A fixation "X" appeared on the screen in one of possible locations in between images to reset the participant's gaze. The images depicted the front of cigarette boxes for the 3 most popular brands (Marlboro, Camel, and Newport) and for all conditions featured a GWL placed prominently on the top of the pack. Each brand appeared 3 times in the rotation of warnings; we rotated brands across warnings to prevent order effects and so that no one warning was consistently associated with any one brand. We modified the font on some labels from the original FDA-approved versions to keep the font size and type consistent across conditions. We also omitted the 1–800-QUIT-NOW quit line number that was a part of the original FDA labels but was a source of controversy in litigation.[23]

The data included in this analysis were merged from 8 randomized experimental studies (4 with each population) testing effects of variations on the full color GWLs originally proposed by the FDA in 2011. The data were collected from participants who viewed full color graphic warnings covering 50% of the cigarette box (AS: N = 590; Y: N = 631), with the exception of individuals assigned to viewed the same warnings sized down to cover 30% of the (AS: N = 73; Y: N = 74) and those who viewed the 50% warnings in black and white (AS: N = 56; Y: N = 59). Of the 50% full color, most saw the original FDA text (AS: N = 197; Y: N = 199). The remaining data were from participants in 2 studies who were randomly assigned to view minimally manipulated versions (described below) of the original text accompanying the warnings, specifically certainty of risk language (AS: N = 256; Y: N = 290) or an added identified sponsor (AS: N = 137; Y: N = 142). The participants with a risk certainty manipulation saw a full color 50% GWL with the text changed per condition to be more or less certain about the depicted heath risk (ie, "*WARNING: Smoking causes cancer* / *will cause cancer* / *can cause cancer* / *may cause cancer").* Participants in the sponsor manipulation saw the original text on the warnings with assigned added variations of an identified sponsor of the warning (*US Food and Drug Administration* or *American Cancer Society*). Data were also merged from a study manipulating size of warning (30% versus 50%). We created indicator variables for warning manipulations in each study and included these variables as controls in all statistical models described below.

Independent Variable Measures: Unobtrusive Eye Tracking

Total fixation duration.—Visual attention to specific areas of interest (AOIs) on the cigarette packs was captured with unobtrusive eye-tracking technology. Participants were seated such that cigarette pack images were at a viewing distance of approximately 64 cm, decisions meant to replicate the angle and distance of holding a pack at arm's-length. We instructed participants to keep their eyes on the screen for all images. Total Fixation Duration (TFD) was the millisecond dwell time on a given AOI. Areas of interest on each label were identified as: *Brand* was isolated as branding information similar to what is currently seen on cigarette packs. Entire *Warning Area* included any warning information such image, text and black space. Within the warning, 2 specific AOIs were identified: *Image Only* and *Text Only.* We analyzed fixation data in 2 ways. First was the total fixation duration (TFD) on an AOI across the 90 seconds of total exposure time to the 9 assigned labels, divided by 9 so that the metric reflects the average per warning label. Second was the time to first fixation (TFF) within the first 10 seconds of viewing time total, no matter which label a participant saw first in random rotation, since that measure captured their initial response to the GWL before respondents were conditioned to what they were about to see.

Dependent Variables: Self-Reported Measures

After viewing the stimuli, participants completed a post-test questionnaire assessing self-reported affective and cognitive responses to the images. We randomized all measures within blocks and all blocks within the questionnaire except for emotional reactions, which we assessed first, and demographics, which we assessed last. We adapted all youth items from previous measures (described below) for potential low-literacy youth (targeting a 4th grade reading level).

Negative emotions.—We gauged negative emotional reactions immediately after viewing the stimuli using a set of 8 items adapted from the Positive and Negative Affect Schedule (PANAS).[24] Participants responded to the prompt, "After looking at the pictures of cigarette packs, I felt…" [afraid, angry, annoyed, sad, disturbed, grossed-out, scared, and guilty] (randomly ordered). Response choices for both populations ran from 1 = *not at all* to 5 = *extremely*. The 8 items were averaged into a single scale of negative affect (Y: α = .82, M = 2.48, SD = .92; AS: α = .89, M = 2.69, SD = 1.03). We also examined each emotion separately in a set of exploratory analyses described in greater detail below.

Message cognitions.—We measured message related cognitions by averaging 3 items varying slightly between youth and adults. For youth, the items were: *The warnings taught me something new, gave me good reasons not to smoke,* and *made me not want to smoke.* Response choices ranged from 1 (strongly disagree) to 4 (strongly agree) *(*Y: α = .66, M = 3.38, SD = .62). Adults responded to *taught me something new, made a strong argument for quitting, and motivated me to quit.* Response choices ranged from 1 (strongly agree) to 5 (strongly disagree) *(*AS: α = .72, M = 3.48, SD = .96).

Health risk beliefs - adult smokers.—We assessed 14 health risk beliefs associated adapted from the Population Assessment of Tobacco and Health (PATH) survey.[25] We

worded these items as follows: “Based on what you know or believe, does smoking cigarettes cause… [items such as*…babies to be born with low birth weight from the mother smoking during pregnancy, heart disease in smokers, lung cancer in smokers*, and *lung disease*, in smokers? We offered participants the response choices of Yes, No, and Not sure. We calculated a belief index by first dichotomizing responses indicating Yes = 1 versus any other response = 0, and then totaling the number of “yes” responses across the fourteen items (range 0–14, $M = 10.16$, $SD = 3.54$).

Health risk beliefs - youth.—We measured twelve items assessing youth’s beliefs about health-related smoking risks (adapted from PATH),[25] asking, “Do you believe cigarette smoking is related to… [items such as…*lung disease, heart disease, problems in babies whose moms smoke, addiction, immediate harm, stroke*]. In one youth experiment, the language of *lung disease* was changed to *deadly lung disease*, there were no differences between the conceptually similar items in reliability checks, therefore they were merged into one item, which was included in the index. Response choices ranged from 1 (definitely not) to 4 (definitely yes). We calculated a health risk belief index by adding the number of responses for which respondents answered “definitely yes” across the twelve items (range = 0 – 12, $M = 7.88$, $SD = 3.05$).

Quit intentions - adult smokers.—We measured quit intentions with 3 items adapted from the National Adult Tobacco Survey.[26] Do you want to quit smoking cigarettes for good? [Yes/No]; Do you have a time frame in mind for quitting? [Yes/No], and do you plan to quit smoking cigarettes for good… (In the next 7 days, In the next 30 days, In the next 6 months, In the next year, More than 1 year from now)? We created a dichotomous measure with planning to quit smoking in the next 6 months or earlier coded as “1” (N = 27%) and not planning to quit, not having a time frame in mind, or planning to quit smoking in > 6 months coded as “0.”

Smoking susceptibility - youth.—We gauged middle-school youth’s susceptibility to smoking using following 5 items, adapted from validated instruments developed by Pierce, et al. (1996) and Jackson (1998).[27,28] Items included: Do you think that... *you will smoke a cigarette soon? you will smoke a cigarette in the next year*? *you will be smoking cigarettes in high school*? *in the future you mi*ght try a cigarette? And *if one of your best friends offered you a cigarette would you smoke it?* Response choices ranged from 1 (definitely not) to 4 (definitely yes). We calculated a susceptibility index by creating a dummy variable for each item whereby we coded definitely not as “0” and anything else as “1”. We then summed across the 5 items (range = 0 – 5, $M = .82$, $SD = 1.33$). After viewing a warning label, 61% youth responded that they *would never would try* across all 5 items, with the remaining participants indicating at least a slight susceptibility on at least one item.

Control Variables

Across both samples, we controlled for sex category identification, age, race, and color-blindness. We also included dummy variables for each original study and randomized condition, as listed in Table 1 (excluding the 50% full color condition in study 1 as the comparison group). This strategy accounts for any differences in outcomes that are

attributable to either the study timing and/or the specific details of the warning label manipulations described above. For youth, we measured several known predictors of smoking susceptibility, including previous smoking behavior, sensation seeking[29] and whether anyone living in their home smoked cigarettes (adapted from Centers for Disease Control and Prevention, 2014).[30] For adult smokers, we measured a variety of factors known to predict quit intentions, including levels of nicotine dependence using the Fagerstrom Test for Nicotine Dependence,[31] and past quit attempts (in the past 12 months). We also controlled for self-reported income and usage of social services such as food stamp programs.

RESULTS

Descriptive statistics are provided in Table 2 and a zero-order correlation matrix for each study population is provided in Table 3 (adult smokers) and Table 4 (middle-school youth).

Attention to AOIs

Adult smokers spent an average of 6.84 seconds (68% of potential viewing 10 seconds per image) gazing at any part of the pictures of cigarette boxes. Youth spent an average of 6.70 seconds (67% of potential viewing 10 seconds) gazing at the boxes. Paired sample, within subject t-tests indicated that, on average, both adult smokers and youth dwelled on the warning area longer than the branded content on the packages (AS: M_{diff} = 3.31, SD_{diff} = 2.42, $t(694) = 36.01$, $p < .001$) (Y: M_{diff} = 2.88, SD_{diff} = 1.92, $t(737) = 40.87$, $p < .001$; see Table 2). In addition, participants in both populations were drawn faster to the warning area compared to the brand AOI (AS: M_{diff} = .55, SD_{diff} = 1.63, $t(673) = 8.75$, $p < .001$) (Y: M_{diff} = .65, SD_{diff} = 1.53, $t(725) = 11.34$, $p < .001$). Within the warning area, the image attracted attention for longer than the text (AS: M_{diff} = .32, SD_{diff} = 1.41, $t(694) = 5.95$, $p < .001$) (Y: M_{diff} = .63, SD_{diff} = 1.21 $t(737) = 14.19$, $p < .001$). The 2 studies revealed different patterns of which AOI within the warning attracted attention faster. Images within the warning attracted attention faster than text for the youth sample (Y: M_{diff} = .18, SD_{diff} = 1.91, $t(706) = 2.43$, $p < .001$). No such difference emerged among adults, who were equally drawn to both image and text (AS: M_{diff} = .09, SD_{diff} = 2.19, $t(659) = 1.15$, $p = .25$).

Visual Attention as a Predictor

We conducted ordinary least squares (OLS) or logistic regression (for dichotomous outcomes quit intentions and smoking susceptibility), regressing total fixation duration and time to first fixation on each area of interest to predict each of the aforementioned outcomes. We present results in Tables 5–8, organized by group (adult smokers first then middle school youth). While we acknowledge that the presence of many statistical tests raises the likelihood of significant findings by chance alone, we chose not to apply a familywise error rate correction in part because several outcomes (eg, discrete emotions) were exploratory analyses designed to aid in the interpretation of larger patterns (the negative emotions scale), and 2 of our independent variable measures (visual attention to the text versus image) were a subset of the larger measure of visual attention to warning label content. We made an effort to interpret findings conservatively, however, by emphasizing patterns that were consistent across populations, independent variable measures, and/or outcomes, and only interpreting

coefficients for discrete emotions when there were significant coefficients for the larger negative affect scale.

Adult smokers.—Among adult smokers, fixation on the tobacco brand information on a cigarette pack predicted less negative affect overall (see Table 5). This relationship appeared to be driven by feeling less disturbed and less guilty. However, the quicker adult smokers fixated on the image within the warning label, the less negative affect they felt, driven by lower levels of feeling disturbed and annoyed. This is in the opposite direction as might be expected. There was no relationship between dwell time or time to first fixation on the warning text. No measure of visual attention predicted health message cognitions, risk beliefs, or intentions to quit smoking (see Table 6). Overall, we conclude that there was no clear relationship between eye tracking measures and key outcomes of interest among adult smokers in our samples.

Youth.—Total fixation duration on the tobacco brand information on a cigarette pack was also predictive of less negative affect among youth (see *Table 7*). Turning to specific discrete emotions, the relationship was driven by feeling less afraid, scared, sad, and angry. The opposite pattern occurred when youth fixated longer on the image within the warning, reporting greater levels of overall negative affect. This relationship was driven by higher levels of reporting feeling afraid, sad, and angry. Our data do not reveal a relationship between dwell time and other discrete emotions such as being grossed out, annoyed or feeling guilty.

Youth who fixated longer on the brand information also tended to report lower health risk beliefs and higher susceptibility to smoke in the future (see Table 8). Additionally, the longer time youth spent looking at a warning, the less susceptible they reported being to smoking in the future. This relationship appears to be driven by fixation on the image rather than the text.

DISCUSSION

To our knowledge, this study is based on the largest set of eye-tracking data specifically looking at attention to GWLs. Eye tracking is an objective and unobtrusive measure of behavior (visual attention). This study is also among the first to explore how gaze on specific content features of cigarette package warning labels associates with outcomes beyond recall. Predicting how attention relates to outcomes – such as negative emotions, risk beliefs, intentions, and susceptibility – is important because these outcomes predict subsequent smoking behavior.[3,28,32]

Tobacco companies have argued that graphic warning labels are a government-imposed emotionally-charged set of messages.[9] Indeed, visual attention strongly predicts emotional reactions for both youth and adults. However, our data reveal 6 noteworthy patterns.

First, GWLs attracted longer visual attention than did branded content across both studies. Thus, it appears that one key function of GWLs is to serve as a distractor from cigarette

company branded imagery on cigarette packaging. This finding is consistent with previous work[13,18] and strengthens the evidence base for these claims.

Second, our data provide evidence that suggests that visual attention to GWLs may be particularly important for youth populations, although perhaps less so for adults. There were no clear patterns of relationship between either eye tracking measure and emotions, cognitions, or risk beliefs among adult smokers. However, as youth dwell longer on the warning, in particular the image within the warning, they reported less susceptibility to smoke in the future. In contrast, youth who fixated longer on the cigarette company branded imagery reported more susceptibility to smoke in the future. The findings provide evidence consistent with the argument that GWLs hold potential to (a) reduce youth's likelihood to initiate smoking and (b) reduce attention on brand components, which are associated with uptake of cigarette smoking in the future.

Third, we also did not find any evidence that attention to any specific AOI was associated with more distal effects for adults, such as intentions to quit. It may be that repeated exposures to GWLs are necessary to produce these effects among populations dependent on nicotine and who have, at least in our data, thought about and attempted to quit in the past.[6]

Fourth, fear may not be the primary emotion related to attention on the warning/image, particularly among youth. In the youth samples, fixation on the warning predicted an increase in sadness, while fixation on the image within the warning predicted higher levels of anger and sadness, as well as fear. While we can only speculate, GWLs may evoke sadness among youth because they know someone who may suffer from smoking or smoking related diseases. This seems particularly likely because half of our sample reported living with smokers. Nevertheless, GWLs appear able to evoke fear and anger if they can attract visual attention to graphic imagery versus text or branded cigarette imagery. Future work may seek to identify specific features of images that link to particular emotional responses (eg, death versus disease versus faces depicting emotion).

Fifth, we did not find any evidence of association between exposure to content features on packages with GWLs and risk perceptions (knowledge of health effects) among either adult smokers or youth. Nevertheless, it is still important to note that GWLs could have a valuable deterrence effect via distraction from cigarette branded imagery. This is consistent with our finding that those who fixated more on brand reported lower health risk beliefs.

Sixth, time to first fixation (TFF) was a weak predictor of study outcomes relative to total fixation duration (TFD). One possibility is that how long a person gazes at an area of interest indicates deeper processing, which may not be the case with how quickly their attention is drawn. An alternative explanation is that TFF only provides time to fixation on the first pack a participant views. The packs were randomly rotated, which means that not every participant viewed a pack with vivid imagery first. Indeed, one of the FDA-approved warning labels featured an inspirational message about the benefits of smoking cessation, which may operate quite differently than graphic depictions of death and disease. There is also significant variation in the nature of graphic imagery included in the FDA-approved warning labels, as only 4 feature depictions of disease and death, with 4 others showing

images depicting adults or youth conveying sadness, fear/confusion, or upset. We are unable to isolate the effects of specific FDA-based GWL imagery because all respondents viewed all versions of the warnings.

An important contribution of our data and set of experiments is the inclusion of at-risk populations in our studies through the use of a mobile lab, which also eliminated the need for respondents to travel to formal lab facilities. We were able to involve populations struggling with poverty, food insecurity, and strong levels of nicotine dependence in our work, groups for whom tobacco bears a particularly large burden of morbidity and mortality. In addition, our studies are some of the first in tobacco studies to include understudied at-risk populations such as youth and socioeconomically disadvantaged populations.

Study Limitations

A major limitation of this study is the correlational nature of the analyses. While these data were drawn from experimental studies, we only included participants exposed to GWLs, so this analysis is not equipped to draw strong causal conclusions. It is quite plausible, for instance, that youth who are susceptible to smoke in the future (and thus have some baseline interest in cigarettes and their imagery) may be more likely to look at the brand AOI because they are by interested in smoking or want to avoid content that runs counter to their attitudes or intentions. Alternate interpretations of patterns of association between total fixation duration and negative emotions, however, seem less plausible; it seems unlikely that propensity to experience a particular emotion would predict increased visual attention to specific areas of the cigarette pack, for instance. Nevertheless, we cannot completely rule out this possibility in the absence of longitudinal follow-up data or a randomized experimental design that would permit such inferences (such as asking respondents to focus their attention on particular parts of the image).

We also note that the overall magnitude of relationships were small in magnitude when statistically significant. This can be seen most clearly in the (standardized) correlation coefficients, which ranged from +/− .09 to .13 for youth. It is possible that these relationships would have been larger with repeated or longer durations of exposure (beyond 90 seconds).

We are also unable to make direct statistical comparisons between the adult smoker and the middle-school youth samples, as most of the outcome variables differed. Doing so would also present a clear confound between age and smoking status. Finally, unlike the true nature of mass distribution of warning labels on cigarette packages, the exposure in this study amounted to only 90 seconds. It is possible that more pervasive and consistent exposure (as might be seen if these warnings were implemented at scale) would be associated with stronger effects, including a stronger correlation between intention and behavior change. It is also possible that the novelty of seeing such warnings for the first time could wear off with subsequent exposures. We cannot speak to either of these possibilities with the design of the current study.

IMPLICATIONS FOR TOBACCO REGULATIONS

In 2013, the FDA decided against pursuing an appeal in the Supreme Court, instead opting to conduct research and revisit the evidentiary base behind GWLs on cigarette packaging. This study provides evidence consistent with the argument that GWLs are indeed an important component of warnings on packages. Images may function as an important addition to text warnings, partly in that they distract from branded content. In addition, fixation on images associate with outcomes related to public health outcomes, such as reduced susceptibility to smoking in youth.

Human Subjects Statement

This study was approved by the IRB at the authors home institutions and meets the ethical standard outlines in Helsinki Declaration of 1975 as revised in 2000. Informed consent (or assent) was obtained from all participants in this research.

Acknowledgments

Research reported in this publication was supported by National Institute of Child Health and Human Development (NICHD) and FDA Center for Tobacco Products (CTP) Award: R01HD079612. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH, the NICHD, or the Food and Drug Administration.

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Table 1

Description of Data Inclusion and Stimuli Control Variables

Stimuli Comparison[a]	Description of Original Studies	Included Stimuli (All included 9 minimally manipulated versions of FDA proposed GWLs with image)	Dummy Variable for Study and Condition Included?	Population (Study)	
				Adult Smoker N = 719	Youth N = 764
1	*Image And Text* Color, B&W, New Text, SGW vs No Warning	[b]Full Color 50%	No (omitted category)	N = 55	N = 57
		Black & White 50%	Yes	N = 56	N = 59
2	*Size Of Warning* 50%, 30% vs No Warning	[b]Full Color 50%	Yes	N = 72	N = 69
		Full Color 30%	Yes	N = 73	N = 74
3	*Hedged Language* May, Will, Does, Can	Full Color 50% May	Yes	N = 65	N = 73
		Full Color 50% Will	Yes	N = 62	N = 75
		Full Color 50% Does	Yes	N = 65	N = 74
		Full Color 50% Can	Yes	N = 64	N = 68
4	Explicit Sponsor Fda, Acs, No Sponsor	[b]Full Color 50%	Yes	N = 70	N = 73
		Full Color 50% FDA	Yes	N = 68	N = 68
		Full Color 50% ACS	Yes	N = 69	N = 74

Note. Other than stimuli noted, all procedures across the 4 stimuli comparisons were consistent within sample populations.

[a]Each stimuli comparison included 2 studies varying by the population under study (Adult Smokers / Middle School Youth).

[b]Full color 50% refers to the originally proposed FDA warnings, but without the quitline information. All post-test measures included in this dataset were the same within the youth and adult samples except where clearly indicated in the manuscript.

Table 2

Adult and Youth Fixation Descriptive Statistics

ADULT SMOKERS					
	Time to First Fixation On AOI (First 10 seconds)		**Total Fixation Duration Average per Pack (90 seconds/9)**		
	N	M(SD)	N	M (SD)	% dwell
Brand	679	1.09 (1.50)	695	1.77 (1.22)	26% (of box)
Whole Warning	683	.54 (.76)	695	5.07 (1.71)	77% (of box)
Text	672	1.29 (1.51)	695	2.29 (1.09)	33% (of box) 45% (of warn)
Image	671	1.18 (1.61)	695	2.61 (1.11)	38% (of box) 51% (of warn)
YOUTH					
	Time to First Fixation On AOI (First 10 seconds)		**Total Fixation Duration Average per Pack (90 seconds/9)**		
	N	M(SD)	N	M (SD)	% dwell
Brand	729	1.16 (1.48)	738	1.91 (.94)	28% (of box)
Whole Warning	733	.51 (.67)	738	4.79 (1.43)	71% (of box)
Text	718	1.20 (1.37)	738	1.99 (.93)	29% (of box) 42% (of warn)
Image	721	1.03 (1.36)	738	2.62 (1.01)	39% (of box) 54% (of warn)

Note: Not all participants fixate on an AOI within 10 seconds.

Table 3

Correlations Among Key Variables for (Adult Smokers)

		1	2	3	4	5	6	7
1.	TFD Brand 90s		−.34***	−.29***	−.25***	−.19***	.06	.15***
2.	TFD Warning 90s			.76***	.77***	−.04	−.31***	−.19***
3.	TFD Text 90s				.18***	−.07	−.20***	−.25***
4.	TFD Image 90s					.02	−.27***	−.05
5.	TFF Brand 1st 10s						.01	−.03
6.	TFF Warning 1st 10s							.43***
7.	TFF Text 1st 10s							
8.	TFF Image 1st 10s							
9.	Overall negative affect							
10.	Afraid							
11.	Angry							
12.	Annoyed							
13.	Disturbed							
14.	Grossed out							
15.	Guilty							
16.	Sad							
17.	Scared							
18.	Message cognitions							
19.	Health risk beliefs							
20.	Intention to smoke							

		8	9	10	11	12	13	14
1.	TFD Brand 90s	.01	−.13***	−.08*	−.09*	−.05	−.12**	−.06
2.	TFD Warning 90s	−.22***	.11**	.06	.06	.07	.14***	.11**
3.	TFD Text 90s	−.08*	.07	.03	.03	.06	.07	.07
4.	TFD Image 90s	−.24***	.10*	.06	.07	.06	.15***	.10*

		8	9	10	11	12	13	14
5.	TFF Brand 1st 10s	.03	−.02	−.03	.00	.01	−.02	−.01
6.	TFF Warning 1st 10s	.50***	−.06	−.02	−.01	−.01	−.08*	−.06
7.	TFF Text 1st 10s	−.01	.00	.00	.07	.07	−.02	−.05
8.	TFF Image 1st 10s		−.06	−.01	−.03	−.09*	−.06	−.07
9.	Overall negative affect			.84***	.73***	.62***	.78***	.74***
10.	Afraid				.51***	.39***	.58***	.55***
11.	Angry					.59***	.48***	.44***
12.	Annoyed						.37***	.39***
13.	Disturbed							.60***
14.	Grossed out							
15.	Guilty							
16.	Sad							
17.	Scared							
18.	Message cognitions							
19.	Health risk beliefs							
20.	Intention to smoke							

		15	16	17	18	19	20
1.	TFD Brand 90s	−.12***	−.11**	−.10**	−.11**	−.00	−.07
2.	TFD Warning 90s	.06	.07	.07	.09*	.00	.05
3.	TFD Text 90s	.07	.04	.07	.06	−.05	.03
4.	TFD Image 90s	.03	.06	.04	.07	.06	.05
5.	TFF Brand 1st 10s	−.04	−.00	−.03	.01	.07	.07
6.	TFF Warning 1st 10s	−.06	−.01	−.01	−.02	−.03	−.00
7.	TFF Text 1st 10s	−.00	−.00	.01	−.00	.01	−.02
8.	TFF Image 1st 10s	−.06	−.01	−.05	−.04	−.01	−.04
9.	Overall negative affect	.71***	.78***	.82***	.54***	.25***	.26***
10.	Afraid	.56***	.65***	.77***	.47***	.22***	.21***
11.	Angry	.41***	.51***	.47***	.31***	.14***	.21***

		15	16	17	18	19	20
12.	Annoyed	.31***	.35***	.37***	.20***	.09*	.14***
13.	Disturbed	.46***	.58***	.60***	.47***	.20***	.18***
14.	Grossed out	.42***	.48***	.55***	.43***	.21***	.19***
15.	Guilty		.50***	.57***	.42***	.20***	.18***
16.	Sad			.58***	.45***	.20***	.22***
17.	Scared				.49***	.23***	.21***
18.	Message cognitions					.28***	.25***
19.	Health risk beliefs						.14***
20.	Intention to smoke						

Note: Cells present Pearson R correlation scores. TFD = Total Fixation Duration on the Area Of Interest. 90s = 90 seconds of total viewing time. 1st 10s = the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI.

* $p \leq .05$,

** $p \leq .01$,

*** $p \leq .001$.

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Table 4

Correlations Among Key Variables for (Middle School Youth)

		1	2	3	4	5	6	7
1.	TFD Brand 90s		−.29***	−.24***	−.21***	−.16***	.06	.01
2.	TFD Warning 90s			.70***	.81***	.01	−.24***	−.11**
3.	TFD Text 90s				.15***	.04	−.19***	−.16***
4.	TFD Image 90s					.00	−.18***	−.02
5.	TFF Brand 1st 10s						.14***	.05
6.	TFF Warning 1st 10s							.44***
7.	TFF Text 1st 10s							
8.	TFF Image 1st 10s							
9.	Overall negative affect							
10.	Afraid							
11.	Angry							
12.	Annoyed							
13.	Disturbed							
14.	Grossed out							
15.	Guilty							
16.	Sad							
17.	Scared							
18.	Message cognitions							
19.	Health risk beliefs							
20.	Intention to smoke							

		8	9	10	11	12	13	14
1.	TFD Brand 90s	.05	−.12***	−.11**	−.09*	−.06	−.05	−.06
2.	TFD Warning 90s	−.18***	.08*	.08*	.05	.03	.06	−.01
3.	TFD Text 90s	−.09*	.04	.02	.02	.02	.04	−.02
4.	TFD Image 90s	−.19***	.07	.08*	.05	.02	.04	.00

		8	9	10	11	12	13	14
5.	TFF Brand 1st 10s	.02	−.06	−.03	−.04	−.04	−.05	−.06
6.	TFF Warning 1st 10s	.48***	−.01	.03	.00	−.00	−.03	−.02
7.	TFF Text 1st 10s	.01	−.07	−.07	−.03	−.01	−.05	−.05
8.	TFF Image 1st 10s		.02	.01	.03	−.00	.03	.01
9.	Overall negative affect			.76***	.70***	.58***	.69***	.66***
10.	Afraid				.40***	.25***	.40***	.41***
11.	Angry					.52***	.37***	.30***
12.	Annoyed						.33***	.27***
13.	Disturbed							.58***
14.	Grossed out							
15.	Guilty							
16.	Sad							
17.	Scared							
18.	Message cognitions							
19.	Health risk beliefs							
20.	Susceptibility to smoke							

		15	16	17	18	19	20
1.	TFD Brand 90s	−.05	−.13***	−.09*	−.04	−.10**	.07
2.	TFD Warning 90s	.07	.09*	.08*	.08*	.05	−.05
3.	TFD Text 90s	.05	.05	.05	.10*	.03	−.01
4.	TFD Image 90s	.05	.08*	.06	.03	.03	−.06
5.	TFF Brand 1st 10s	−.03	.00	−.08*	−.05	−.04	−.01
6.	TFF Warning 1st 10s	.01	−.05	.04	−.06	.03	−.05
7.	TFF Text 1st 10s	−.02	−.08*	−.02	−.03	−.00	−.07
8.	TFF Image 1st 10s	−.02	−.04	.05	−.09*	−.01	.00
9.	Overall negative affect	.45***	.72***	.75***	.24***	.21***	−.09*
10.	Afraid	.26***	.51***	.74***	.18***	.14***	−.07*
11.	Angry	.27***	.48***	.37***	.13***	.17***	−.07

		15	16	17	18	19	20
12.	Annoyed	.25***	.29***	.19***	.07	.15***	−.05
13.	Disturbed	.17***	.37***	.41***	.23***	.19***	−.09*
14.	Grossed out	.13***	.30***	.42***	.15***	.14***	−.07
15.	Guilty		.30***	.25***	.08*	.04	.03
16.	Sa			.52***	.24***	.18***	−.11
17.	Scared				.19***	.11**	−.04
18.	Message cognitions					.15***	−.19***
19.	Health risk beliefs						−.29***
20.	Susceptibility to smoke						

Note: Cells present Pearson R correlation scores. TFD = Total Fixation Duration on the Area Of Interest. 90s = 90 seconds of total viewing time. 1st 10s = the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI.

* p ≤ .05,

** p ≤ .01,

*** p ≤ .001.

Table 5

Ordinary Least Squares (OLS) Regression Models, Regressing TFD and TFF on Negative Affect, Adult Smokers

	Overall Negative Affect	Afraid	Scared	Sad	Grossed Out
Fixation Area					
TFD Brand 90s	**−.07 (.03)** *	−.04 (.04)	−.06 (.04)	−.08 (.04)	−.06 (.05)
TFF Brand 1st 10s	−.01 (.03)	−.02 (.04)	−.02 (.04)	−.01 (.04)	−.01 (.04)
TFD Warning 90s	.04 (.02)	.03 (.03)	.03 (.03)	.03 (.03)	**.06 (.03)** *
TFF Warning 1st 10s	−.09 (.06)	−.07 (.07)	−.04 (.07)	−.02 (.07)	−.10 (.07)
TFD Text 90s	.03 (.04)	−.003 (.05)	.04 (.05)	.02 (.05)	.04 (.05)
TFF Text 1st 10s	.002(.03)	−.004 (.04)	.01 (.04)	−.002 (.04)	−.05 (.04)
TFD Image 90s	.07 (.04)	.05 (.05)	.04 (.05)	.05 (.05)	**.10 (.05)** *
TFF Image 1st 10s	**−.06 (.03)** *	−.03 (.04)	−.06 (.04)	−.03(.04)	−.07 (.04)

	Disturbed	Annoyed	Guilty	Angry
Fixation Area				
TFD Brand 90s	**−.09 (.04)** *	−.03 (.04)	**−.11 (.05)** *	−.07(.04)
TFF Brand 1st 10s	−.02 (.04)	.01 (.03)	−.04 (.04)	−.000 (.03)
TFD Warning 90s	**.10 (.03)** ***	.03 (.03)	.02 (.03)	.03 (.03)
TFF Warning 1st 10s	**−.15 (.07)** *	−.02 (.07)	−.13 (.07)	−.05 (.07)
TFD Text 90s	.07 (.05)	.03 (.05)	.05(.05)	.002 (.05)
TFF Text 1st 10s	−.02 (.04)	.05 (.03)	.01 (.04)	.05 (.03)
TFD Image 90s	**.17 (.05)** ***	.05 (.05)	.01 (.05)	.07 (.05)
TFF Image 1st 10s	**−.07 (.04)** *	**−.07 (.03)** *	−.08 (.04)	−.04 (.03)

Note. Cells present unstandardized regression coefficients and standard errors. All models were ordinary least squares (OLS) regressions. TFD=Total Fixation Duration on the Area Of Interest. 90s= of 90 seconds total viewing time. 1st 10s = of the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI (caution: lower values equal faster TFF). All analyses included stimuli covariates listed in Table 1 as well as age, male, other sex, Hispanic, Black, other race, previous smoking, living with a Smoker, sensation seeking, colorblindness, and experimental manipulations.

* p ≤ .05,

** p ≤ .01,

*** $p \leq .001$.

Table 6

Ordinary Least Squares (OLS) and Logistic Regression Models, Regressing TFD and TFF on Message Cognitions, Health Risk Beliefs, and Intentions to Quit, Adult Smokers

	Message Cognitions (OLS Regression)	Health Risk Beliefs (OLS Regression)	Intentions to Quit (Logistic Regression)
Fixation Area			
TFD Brand 90s	−.05 (.03)	.00 (.11)	−.07 (.08)
TFF Brand 1st 10s	−.003 (.02)	.12 (.09)	.07 (.06)
TFD Warning 90s	.03 (.02)	−.03 (.08)	.04 (.06)
TFF Warning 1st 10	−.01(.05)	−.19 (.18)	.05 (.13)
TFD Text 90s	.03 (.03)	−.22 (.12)	−.02 (.09)
TFF Text 1st 10s	−.001 (.02)	.01 (.09)	−.01 (.07)
TFD Image 90s	.05 (.03)	.14 (.12)	.10 (.09)
TFF Image 1st 10s	−.02 (.02)	−.05 (.09)	−.04 (.07)

Note. Cells present unstandardized regression coefficients and standard errors. All models were ordinary least squares (OLS) regressions except for the model predicting susceptibility to smoke, which was a logistic regression model. TFD=Total Fixation Duration on the Area Of Interest. 90s= of 90 seconds total viewing time. 1st 10s = of the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI (caution: lower values equal faster TFF). All analyses included stimuli covariates listed in Table 1 as well as age, male, other sex, Hispanic, Black, other race, previous smoking, living with a smoker, sensation seeking, and colorblindness.

* $p \leq .05$,

** $p \leq .01$,

*** $p \leq .001$.

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Table 7

Ordinary Least Squares (OLS) Regression Models, Regressing TFD and TFF on Negative Affect, Middle-School Youth

	Overall Negative Affect	Afraid	Scared	Sad	Grossed Out
Fixation Area					
TFD Brand 90s	**−.12 (.04)** **	**−.15 (.06)** *	**−.12 (.06)** *	**−.20 (.06)** ***	−.10(.06)
TFF Brand 1st 10s	−.04 (.02)	−.03 (.04)	**−.09 (.04)** *	−.01 (.04)	−.06(.04)
TFD Warning 90s	.04 (.02)	.06 (.04)	.06 (.04)	**.07 (.04)** *	−.003 (.04)
TFF Warning 1st 10s	−.01 (.05)	.06 (.08)	.07 (.08)	−.10 (.08)	−.06(.08)
TFD Text 90s	.01 (.04)	−.01 (.07)	.04 (.07)	.05 (.07)	−.05(.07)
TFF Text 1st 10s	.−.04 (.03)	**−.09 (.04)** *	−.03 (.04)	−.07 (.04)	−.04 (.04)
TFD Image 90s	**.08 (.03)** *	**.12 (.06)** *	.09 (.05)	**.11 (.05)** *	.02 (.06)
TFF Image 1st 10s	.01 (.03)	.01 (.04)	.06 (.04)	−.03 (.04)	.01 (.04)

	Disturbed	Annoyed	Guilty	Angry
Fixation Area				
TFD Brand 90s	−.09 (.06)	−.10 (.06)	−.04(.04)	**−.15 (.05)** **
TFF Brand 1st 10s	−.05 (.04)	−.02 (.04)	−.01 (.03)	−.03 (.03)
TFD Warning 90s	.05 (.04)	.04 (.04)	.03 (.03)	.05 (.04)
TFF Warning 1st 10s	−.07 (.08)	−.01 (.08)	.04 (.06)	−.02 (.08)
TFD Text 90s	.07 (.06)	.01 (.06)	.01 (.05)	.01 (.06)
TFF Text 1st 10s	−.05(.04)	.01(.04)	−.002 (.03)	−.003 (.04)
TFD Image 90s	.05(.05)	.07 (.05)	.06 (.04)	**.10 (.05)** *
TFF Image 1st 10s	.04 (.04)	−.02 (.04)	−.02 (.03)	.02 (.04)

Note. Cells present unstandardized regression coefficients and standard errors. All models were ordinary least squares (OLS) regressions. TFD=Total Fixation Duration on the Area Of Interest. 90s= of 90 seconds total viewing time. 1st 10s = of the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI (caution: lower values equal faster TFF). All analyses included stimuli covariates listed in Table 1 as well as age, male, other sex, Hispanic, Black, other race, previous smoking, living with a Smoker, sensation seeking, colorblindness, and experimental manipulations.

* $p \leq .05$,

** $p \leq .01$,

*** $p \leq .001$.

Table 8

Ordinary Least Squares (OLS) Regression Models, Regressing TFD and TFF on Message Cognitions, Health Risk Beliefs, and Susceptibility to Smoke, Middle-School Youth

	Message Cognitions (OLS Regression)	Health Risk Beliefs (OLS Regression)	Susceptibility to Smoke (OLS Regression)
Fixation Area			
TFD Brand 90s	−.03 (.03)	**−.43 (.13)** ***	**.12 (.05)** *
TFF Brand 1st 10s	−.02 (.02)	−.06 (.08)	**−.01 (.03)**
TFD Warning 90s	.03(.02)	.13 (.08)	**−.07 (.03)** *
TFF Warning 1st 10s	−.06 (.04)	.11 (.18)	−.06 (.07)
TFD Text 90s	**.06 (.03)** *	.15 (.14)	−.07 (.06)
TFF Text 1st 10s	−.02 (.02**)**	.01 (.09)	−.04 (.04)
TFD Image 90s	.01 (.03)	.15 (.12)	**−.09(.05)** *
TFF Image 1st 10s	**−.04 (.02)** *	−.05 (.09)	.02 (.04)

Note. Cells present unstandardized regression coefficients and standard errors. All models were ordinary least squares (OLS) regressions. TFD=Total Fixation Duration on the Area Of Interest. 90s= of 90 seconds total viewing time. 1st 10s = of the first 10 seconds of viewing time on first label exposure. TFF=Time to First Fixation on the AOI (caution: lower values equal faster TFF). All analyses included stimuli covariates listed in Table 1 as well as age, male, other sex, Hispanic, Black, other race, previous smoking, living with a Smoker, sensation seeking, colorblindness, and experimental manipulations.

* p ≤ .05,

** p ≤ .01,

*** p ≤ .001