

# **Do Young Adults Attend to Health Warnings in the First IQOS Advertisement in the U.S.?**

## **An Eye-Tracking Approach**

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## ABSTRACT

**Introduction:** In October 2019, a heated tobacco product (HTP) IQOS debuted in the United States. This study examined young adults' attention and cognitions in response to an IQOS ad that carried two mandated textual health warnings (Surgeon General's warning and nicotine warning), and how their vaping and smoking status may interact with attention patterns to affect attitude and intention to use IQOS.

**Methods:** In November 2019, college students (N=164) viewed IQOS' first U.S. magazine ad and two distractor ads. Viewing patterns were recorded with eye-tracking. Masked recall and aided recognition, attitude and intention towards IQOS use were later assessed with self-report. OLS regressions and moderated mediation analyses examined the associations between visual attention and viewers' cognitions about IQOS use.

**Results:** Promotional content attracted significantly more attention compared to the warnings. Attention to the Surgeon General's warning but not to the nicotine warning was associated with recall and recognition of the warning's content. For ever-vapers, greater attention allocation to the promotional content in the IQOS ad was associated with more favorable attitude toward IQOS use, which was in turn positively associated with intention to use IQOS. Attention allocation to the warnings did not affect attitude or intentions, regardless of tobacco use status.

**Conclusions:** The results revealed the effects of IQOS promotional content overshadowed the two health warnings in influencing young people's attitude and intention to use IQOS. Young adults who vaped were more vulnerable to HTP advertising with respect to future use and vaping may be a gateway to HTP use.

Keywords: IQOS; warning labels; eye-tracking; heated tobacco products; advertising

## IMPLICATIONS

This is the first eye-tracking study examining attention and cognitions associated with the new IQOS ad exposure among young adults. Promotional content in the ad attracted significantly more attention than the two warnings combined. Attention to the Surgeon General's warning but not to the nicotine warning was associated with recall and recognition of the warning's content. Greater attention allocation to the promotional content led to more favorable attitude toward IQOS use which was associated with increased intention to use IQOS for ever vapers. However, greater attention allocation to the warnings did not affect attitude or intentions to use IQOS.

## INTRODUCTION

In October 2019, a heated tobacco product (HTP) IQOS debuted in the U.S. market.<sup>1,2</sup> As of 2019, IQOS had \$900 million in sales and eight million users worldwide.<sup>3</sup> HTPs heat rather than burn tobacco, although evidence to date on whether they are less harmful than cigarettes is inconclusive.<sup>4,5</sup> Globally, Philip Morris International (PMI) has been aggressively marketing IQOS, particularly to young adults.<sup>6</sup> The first IQOS magazine ad appeared in the U.S. in September 2019 (Figure 1A) in magazines such as *Men's Journal* and *Vogue*<sup>7</sup> that reach substantial numbers of young adults.<sup>8,9</sup>

IQOS products and advertisements are required to carry two textual warnings in the U.S.: one of three rotating Surgeon General's warnings for cigarettes along with a nicotine warning "*WARNING: This product contains nicotine. Nicotine is an addictive chemical.*"<sup>10</sup> These warnings are placed alongside the prominent and clearly visible promotional branding content on the first IQOS ad. Given that visual attention is the essential first step of selective information processing, encoding and retention<sup>11</sup>, understanding the visual attention allocation to warning and promotional content on IQOS' advertisements is critical with regard to the downstream effects on viewers' cognitions and behaviors.<sup>12-14</sup>

Eye tracking provides a psychophysiological measure that is an exogenous, direct and valid indicator of visual attention and is especially informative when used in conjunction with other self-report cognitive measures.<sup>15</sup> Research indicates the positive link between visual attention to health warnings and increased recall, risk perceptions about smoking, and intentions to reduce smoking.<sup>16-19</sup> However, it has also been noted that due to avoidance and habituation, textual health warnings on cigarette packs or tobacco ads are often ignored.<sup>15</sup> Moreover, salient promotional content can further compete for attention and cognitive resources, resulting in poor

recall and limited effectiveness of the warnings. Such distractive influence has been corroborated by studies on plain packaging which observed that limiting<sup>12</sup> or removing<sup>20–22</sup> promotional branding elements from cigarette packs increased time spent on viewing health warnings, and reduced viewers' cigarette preference.

IQOS has been marketed as sleek, chic, sophisticated, and high-tech, invoking nostalgia for smoking real tobacco (as compared to vaping e-cigarettes) but in a cleaner, more modern, and purer way with less ash and odor (as compared to smoking combustible cigarettes).<sup>23</sup> Such product positioning can be particularly appealing to younger populations, and may mislead the consumers into thinking that it is a “lighter,” “milder,” and less harmful alternative, potentially offsetting the protective influence from the warnings.<sup>24,25</sup> To date, no study has examined young people's viewing patterns when exposed to the IQOS ad, and how their attention allocation to the promotional and warning elements is associated with attitude and intention toward IQOS use, which are important antecedents to their subsequent IQOS use behavior according to health behavior theories.<sup>26</sup>

In this study, eye-tracking, along with measures of masked recall, aided recognition, attitude and intention were used to examine young adults' attention and cognitions to the first IQOS print advertisement in the U.S. Young adulthood is a critical time in the transition from adolescence to adulthood, when changes in risk-taking behaviors such as tobacco use are more frequent.<sup>27</sup> Given IQOS' potential to attract many new users among young adults, especially those at the college-aged years, a period of heightened risk for tobacco use initiation<sup>28</sup>, it is crucial to understand how the IQOS ad will influence their perceptions toward IQOS, and whether the mandated warnings are effective in dissuading use. Considering the differences in sizes, emphases (health consequences vs. addiction risk) and novelty associated with the Surgeon

General's Warnings and the nicotine warning, it is important to examine their individual and collective ability to attract and retain attention, as well as how well they compete for cognitive resource allocations with the promotional content in the IQOS ad. In addition, previous eye-tracking research of health warnings on cigarette packages identified the potential moderating influence from smoking status such that viewing time on warnings was less likely to impact cognitions of smokers, probably due to either their top-down volitional control when exposed to threatening information, desensitization or habituation through repeated exposure, or heightened salience and preference for the brand.<sup>20,21</sup> Given that IQOS can appeal to both smokers and vapers, this study also aims to examine whether ever vaping/smoking status moderates the influence of visual attention allocation. Finally, considering that attitude has been consistently found to be a prominent predictor of intention,<sup>26,29</sup> we also investigate whether attitude mediates the relationship between attention and intention. Taken together, a moderated mediation analysis is performed to examine how attention allocation interacts with one's tobacco use status to influence their attitude, which in turn affects their intention to use IQOS.

## **METHODS**

### **Sample and procedures**

College students (n=177) were recruited from a large southern public university and received course credit for participation. The analytical sample involved data from 164 participants; excluding 9 participants who failed to pass the validation criteria (described below) and 4 who experienced technical issues. All study sessions were conducted in a quiet research laboratory room. Trained research assistants explained procedures and obtained informed consent. Participants were unaware the study was related to tobacco. They were informed they would view and then respond to questions related to three magazine advertisements. During the

eye-tracking session, participants viewed the three ads at their own pace, with an automatic 3-second empty screen between each ad. After the ad exposure, participants completed an online post-exposure survey in the lab. They were then debriefed, thanked and dismissed. The study took approximately 30 minutes. The study was conducted November – December 2019, with data cleaning and analysis in January – February 2020. The study was approved by the University of Georgia IRB.

### Stimuli

The IQOS magazine ad published in *Men's Journal* and *Vogue* (Figure 1A) displayed a visual of a heat stick (which is the heated tobacco unit that contains filter sections and dried tobacco material wrapped in paper, and is inserted to the IQOS holder to be heated up for use) with the device and charger against a black background. The promotion text was “*Meet IQOS. Real tobacco, no ash, less odor*”. The FDA-mandated nicotine warning covered the top 20% of the ad, while a Surgeon General’s warning was placed in the lower left (3% of the ad).<sup>10</sup> The ad stimulus was created to be roughly the same size on screen as the actual size in a standard magazine. Following prior practices,<sup>30,31</sup> we also identified and had participants view two distractor ads featuring non-tobacco products – one was for a large-capacity USB drive, the other was for an electric vehicle. These ads were similar to the IQOS ad in color scheme, image size, and the amount of text. The ads appeared in a fixed order: USB drive first (mean viewing time 31.75s [ $SD=16.65s$ ]), IQOS second (29.89s [ $SD=13.21s$ ]), and electric vehicle the third (29.07s [ $SD=13.97s$ ]).

## Measures

### *Eye-tracking Measures*

A Tobii Pro Nano screen-based eye-tracker with a sampling rate of 60 Hz mounted on a 15.6-inch laptop (Dell XPS 15 with a screen resolution of 1920×1080 pixels) was used. Tobii Pro Lab software was used for stimuli presentation and analysis. Participants were seated about 60-65cm from the display. For each participant, the system was calibrated using a set of five calibration targets/points covering the entire screen area. Eye calibrations were checked and verified so that the average error in eye position was less than .5 degrees and 6.3 mm. Participants' data were considered ineligible if they failed to pass the above validation criteria for five consecutive calibrations. Four areas of interest (AOIs) were identified a priori: (1) the nicotine warning (*NW AOI*), (2) the Surgeon General's Warning (*SGW AOI*), (3) the promotional text (*PT AOI*) and (4) the promotional visual (*PV AOI*) (see [Figure 1B](#)).

For each AOI, three outcomes were assessed: number of fixations, total fixation duration, and time to first fixation. A fixation represents a brief period of time (measured in milliseconds) during which the eye stays stationary and still, holding the central foveal vision in place so that the visual system can take in detailed information about an element or object of interest.<sup>32,33</sup> Fixation was operationalized as two consecutively sampled gaze points possessing a speed below the velocity threshold set in the Tobii I-VT gaze filter.<sup>34</sup> *Number of fixations* (also known as frequency of fixation, or fixation count) signals attention and cognitive processing of a stimulus element at a given moment.<sup>33,35</sup> *Total fixation duration* (also known as dwell time or fixation length) is a time-based measure derived from the fixation-based metrics; it is calculated by aggregating duration of fixations upon an AOI within a stimulus, and is considered to reflect one's depth of cognitive processing.<sup>32,36,37</sup> *Time to first fixation* is an entry/latency time measure

which indicates the amount of time that it takes a participant to look at a specific AOI from stimulus onset; it can often reflect visual saliency, i.e., how certain aspects of a stimulus are prioritized and a stimulus element's ability to grab visual attention.<sup>17,38</sup> All eye-tracking metrics were measured in milliseconds, and were later converted to seconds to facilitate analysis and interpretation.

Following prior practice<sup>31</sup>, two percentage outcome measures were calculated to account for the variations in participants' general viewing speed, and to reflect how participants allocated their attention and cognitive resources into different areas of the ad during their viewing time. Specifically, we combined the total raw fixation durations in NW and SGW AOIs and divided by the total viewing time of the IQOS ad to generate *percentage of attention to warning AOIs*. We combined the total raw fixation durations in PT and PV AOIs and divided by the total viewing time of IQOS ad to generate *percentage of attention to promotional content AOIs*.

#### *Masked Recall*

Immediately following the eye-tracking session, we covered the two warning areas and the dominant pictorial element of the ad (i.e., the promotional visual of the IQOS device on top of a charging device) and asked participants to recall and write down, in as much detail as possible, what was in each of the covered areas (Figure 1C). The promotional text area was not covered to serve as a reference point that facilitated participants' mental reconstruction of the relative positions of the different ad components. Using a coding system adopted from Krugman et al.<sup>17</sup>, participants' responses were categorized into one of four recall accuracy levels (1=incorrect, irrelevant or no recall; 2=recalled the presence of warnings with no specific information provided; 3=recalled important concepts in the warnings; 4=recalled exact wording of the warnings). Similarly, for the covered visual area, we coded participants' responses using a

four-point scale (1 = *incorrect, irrelevant or no recall*; 2=*recalled the presence of the visual of the device with no specific information provided*; 3=*provided specific but incorrect description of the visual*; 4=*provided specific and correct description of the visual*). To understand if participants thought about IQOS in relation to cigarettes and electronic cigarettes (e-cigarettes), explicit mentions of those two tobacco products were coded (1=*presence*, 0=*absence*). We further examined descriptions that included mentions of either product to see whether participants confused them with IQOS or considered IQOS to be similar to the product(s). Two trained coders coded the responses (average inter-coder reliability  $\kappa=.87$ , ranging from .84 to .95). Disagreements were resolved through discussions between the coders.

#### *Aided Recognition*

In line with recommended practice,<sup>30</sup> aided recognition of the two warning messages (masked areas 1 & 3 in [Figure 1C](#)) was conducted after masked recall. Participants were asked to identify the correct information in the two covered areas from two lists that each included three similar distractor items. Sample distractor items include “*This product is not a safe alternative to cigarettes*” for the NW, and “*Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy*” for the SGW.

#### *Attitude and Intention toward IQOS Use*

Attitude toward IQOS use was measured with a 6-item semantic differential scale: “In your opinion, using IQOS in the next 6 months would be ...” *bad-good, difficult-easy, foolish-wise, harmful-beneficial, unpleasant-pleasant, and unenjoyable-enjoyable*, with 1 indicating the least favorable attitude and 6 the most favorable. The six items were averaged into an attitude scale (Cronbach’s  $\alpha=.78$ ;  $M=2.13$ ,  $SD=.84$ ). Intention to use IQOS ( $M=1.41$ ,  $SD=.59$ ) was

assessed by asking participants how likely that they are to try IQOS, even one or two puffs, at any time in the next 6 months, with 1=*definitely will not* and 4=*definitely will*.

### *Demographics and Ever Tobacco Use*

Participants reported their age, sex, race/ethnicity. Ever use of e-cigarettes and combusted cigarettes was measured by asking the participants whether they had ever tried vaping/smoking, even one or two puffs.

### **Statistical analysis**

Descriptive analyses examined the eye-tracking, masked recall, and aided recognition measures for the AOIs. In each AOI, OLS regressions examined the relationships between raw fixation measures and masked recall and aided recognition. OLS regressions assessed the main and interaction effects of attention allocation (i.e., the percentage of total fixation duration in the combined warning AOIs and combined promotional content AOIs) on participants' attitude and intention toward IQOS use and how their vaper and smoker status moderated the relationships. Bootstrapped procedures using the SPSS macro PROCESS<sup>39</sup> were used in the moderated mediation model and to understand the conditional indirect effects. All regressions controlled for demographic variables. Analyses were conducted using SPSS 25.0 and Stata 14.0.

## **RESULTS**

### **Sample demographic characteristics**

The sample was 62.8% female, 79.3% White, 9.1% African American, 7.9% of Asian or Pacific islander origin, and 3.7% multiple races; 58.5% ever tried e-cigarettes and 28.7% ever smoked. Mean age was 19.1 ( $SD=1.54$ ; range: 18-25).

## Eye-tracking measures

Participants spent on average 29.89s ( $SD=13.21$ ) viewing the IQOS ad, during which they spent 17.8% of their total viewing time in the promotional text (PT) AOI ( $M=5.20s$ ,  $SD=2.76s$ ), 17.0% in the nicotine warning (NW) AOI ( $M=5.08s$ ,  $SD=2.84s$ ), 16.7% in the promotional visual (PV) AOI ( $M=5.16s$ ,  $SD=4.20s$ ), and 12.5% in the Surgeon General's Warning (SWG) AOI ( $M=3.73s$ ,  $SD=2.91s$ ). The promotional content AOIs had significantly higher fixation counts ( $M=36.61$ ,  $SD=17.36$ ) and total fixation durations ( $M=10.36s$ ,  $SD=5.84s$ ) compared to warning AOIs (fixation counts:  $M=31.27$ ,  $SD=15.92$ ,  $t(163)=-3.78$ ,  $p<.001$ ; and total fixation durations:  $M=7.68s$ ,  $SD=4.15s$ ,  $t(163)=-5.45$ ,  $p<.001$ ). For time to first fixation, the NW AOI attracted attention the fastest ( $M=.81s$ ,  $SD=1.86s$ ), with the promotional text area "Meet IQOS" second fastest ( $M=1.54s$ ,  $SD=1.66s$ ). Comparing the two warning areas, participants fixated significantly more often on NW ( $M=20.29$ ,  $SD=10.54$ ) compared to SGW ( $M=11.08$ ,  $SD=7.65$ ),  $t(162)=12.68$ ,  $p<.001$ . Total fixation duration was significantly higher within the NW AOI ( $M=4.29s$ ,  $SD=2.38$ ) compared to the SGW AOI ( $M=3.42s$ ,  $SD=2.62$ ),  $t(162)=3.92$ ,  $p<.001$ . NW attracted participants' attention significantly faster (time to first fixation,  $M=.81s$ ,  $SD=1.86$ ) compared to SGW ( $M=11.28s$ ,  $SD=5.92$ ),  $t(162)=-20.80$ ,  $p<.001$ .

## Recall and recognition

Masked recall of the two warnings was significantly different ( $\chi^2(3)=25.86$ ,  $p<.001$ ) (detailed coding results can be found in online supplement Table S1). Specifically, despite the small area of SGW, participants were more likely to report the presence of the SGW than NW (20.7% vs. 12.8%) and identify correct concepts in the warning (65.2% vs. 54.9%). However, participants more frequently restated the NW verbatim compared to SGW (15.9% vs. 1.2%). For aided recognition, 96.3% and 81.1% were able to identify the correct wording for the NW and

SGW, respectively. Some participants (2.4%) referred to the NW as the “Surgeon General’s warning” and 16% described SGW as a warning about nicotine (e.g., “surgeon general’s warning about how nicotine use during pregnancy can result in damage to the fetus”).

In the masked recall for the PV area, 23.8% of the participants mentioned e-cigarettes and 24.4% mentioned cigarettes when they described the IQOS device. Among those who referenced e-cigarettes, the majority (64.1%) confused IQOS with an e-cigarette (e.g., “a picture of a black e-cigarette on a charging stand”) while 35.9% described it by referencing a vaping device (e.g., “a picture of the product which was a slender vape-like device but rounder like a pen”). Among those who referenced cigarettes, 62.5% referred to the heat stick as a real, regular cigarette (e.g., “image of a tobacco burner with a real cigarette inserted”; “a cigarette was placed inside of a vape”), and 37.5% emphasized the similarity between the heat stick and a cigarette (e.g., “cigarette-looking front on the left side”). A substantial proportion of the participants (22.0%) mentioned both e-cigarettes and cigarettes in their descriptions, such as “it is a vape device that can be used to burn a real cigarette.”

The association between the eye-tracking measures for the NW AOI and masked recall and aided recognition in the corresponding AOI was not significant (Table 1). For the SGW AOI, greater fixation counts and total fixation durations were significantly associated with both more accurate masked recall and aided recognition.

### **Moderated mediation analyses**

For the warning AOIs, neither the main effects nor the interaction effects of the percent attention were significantly associated with attitude and intention to use IQOS (Table 2). However, percent attention allocated to the promotional content AOIs had a significant positive association with attitude toward IQOS ( $\beta=.19, p<.05$ ), although it was not a significant predictor

of intention. In addition, ever smoking status was not found to be a significant moderator between percent attention allocated to the promotional content AOIs or the warning AOIs, and attitude or intention. Ever vaping status, on the other hand, moderated the association between percent attention allocated to the promotional content AOIs and attitude toward IQOS. Further decomposition of the interaction term revealed that the association was significant and positive only for ever vapers ( $\beta=.36, p=.006$ ). The more attention ever vapers allocated to the promotional content, the more favorable attitude towards IQOS they had. For never vapers, the association was not significant ( $\beta=-.12, p=.395$ ).

While the direct effect of attention to the promotional content AOIs on intention was not significant, we conducted a moderated mediation analysis to investigate whether an indirect effect of attention on intention via attitude change existed. This analysis was done because attitude is considered an important antecedent to intention,<sup>26,29</sup> and a significant and positive attitude-intention association was observed in our study ( $r=.56, p<.001$ ). The analysis indicated greater attention allocation to promotional content AOIs was associated with more favorable attitude toward IQOS use, which in turn was significantly and positively associated with intention to use IQOS (Figure 2). The direct effect of attention on intention remained non-significant before and after controlling for attitude, representing a full mediational pathway via attitude. The significant conditional indirect effect was confirmed with PROCESS's bootstrapping procedures (with 5,000 resamples) among vapers (indirect ES=.415, 95%CI = [.307-1.509]). This analysis indicated that vapers' attention allocation to promotional content indirectly increased their intention to try IQOS through a more positive attitude toward the product. The conditional indirect effect was not observed among non-vapers, as indicated by the inclusion of zero in the bias-corrected 95% confidence intervals (indirect ES=-.585, 95%CI= [-

1.216-.422]). The moderated mediation effect was significantly different across vapor vs. non-vapor groups (ES=1.21, 95%CI= [.302-2.298]).

## DISCUSSION

This study used eye-tracking to investigate young adults' visual attention to the warnings and promotional content in a print advertisement for IQOS, a new heated tobacco product. The results indicated young adults attended to the two textual warnings in the ad, but the ad's promotional content attracted significantly more attention, including frequency and duration of gaze. This finding is consistent with published findings related to tobacco warnings.<sup>17,19,40</sup>

In line with previous research,<sup>16,17,19,40</sup> the more visual attention given to the SGW, the more likely individuals were to correctly recall and recognize the specific content. However, for the NW, visual attention was not associated with better recall or recognition. While the SGW contains a longer text but takes up a smaller, non-prominent space, the NW is shorter, has a larger size and is placed prominently. Our findings showed NW attracted visual attention quickly and likely because of its large size, prominence, and simplicity, even participants who spent less time overall attending to it were still able to correctly recall its message. While it was not possible to discern whether the visual salience or the simple message drove that, a large warning at the top of a tobacco product ad is likely better positioned to deliver a warning message than a small one at the bottom, echoing findings from Klein et al.<sup>31</sup>. The fast time to first fixation in NW may also have the potential to influence viewers' mental framing and lead them to approach promotional content with greater caution. It is worth noting that, in the masked recall, participants were more likely to report the presence and identify correct concepts of SGW than NW. This is likely because the concrete, specific language being used in SGW (e.g., "pregnant women," "fetal injury") is more salient when prompted for recall, compared to the general

reference to nicotine addictiveness in NW. These findings provide important insights to inform future regulatory considerations regarding the design features of the warning labels, such that large size, prominent position, simple but concrete language may attract greater visual attention and facilitate subsequent recall.

About 16% of participants described the SGW as a warning about nicotine even though it did not mention nicotine. In their recall, these participants had mistakenly indicated that nicotine use was the major cause of severe health consequences of smoking (such as fetal injury). This might be the result of exposure to NW, which prominently featured nicotine, but is more likely caused by the pre-existing belief that nicotine is the main cause of smoking-related harms, which are held by 50-80% of the U.S. adults.<sup>41,42</sup> For smokers who seek quitting aids, misperceptions about the high health risks associated with nicotine may discourage the use of safe and effective quitting tools such as nicotine replacement therapy. This novel finding reveals the need to further study whether consumers can effectively distinguish the “health consequences” vs. “nicotine addiction” themes present in different warnings. In addition, given the recent authorization of a modified exposure claim for IQOS, it is necessary to evaluate whether consumers interpret the claim about reduced exposure to harmful chemicals as reduced exposure to nicotine, which many of them consider to be the main harmful constituent in tobacco products.

In July 2020, FDA authorized the marketing of IQOS with a modified exposure claim that switching to IQOS reduces body’s exposure to harmful chemicals. This modified exposure claim is now prominently featured on the IQOS website and will likely appear on advertisements in the near future. In the studies that PMI submitted as part of the modified risk tobacco product application (MRTPA), only one paired the proposed claim with the SGW, but not with the NW. The other MRTPA studies tested PMI’s own “important warning” which tried to communicate

that reduced exposure does not mean reduced risk and that IQOS can still cause harm and disease. PMI's qualitative studies showed that participants were confused when seeing modified exposure claim along with the PMI's warning<sup>25</sup>. Thus, it is important to examine the reactions to and effect of this claim, particularly when it is paired with the warnings required by the FDA.

Overall, visual attention to the warnings was not associated with attitude and intention to use IQOS. However, the findings suggest IQOS advertising may positively influence an important sub-population - ever vapers. Among ever vapers, visual attention to promotional content had a significant positive association with attitude towards IQOS. Additionally, for ever-vapers, greater attention to promotional content was associated with more favorable attitude towards IQOS use, which, in turn, was significantly and positively associated with their intentions to use IQOS. This suggests that young adults who vaped may be more vulnerable to HTP advertising and future use, signaling the necessity for continued research to investigate whether e-cigarettes are a gateway to HTP use. This finding points to the necessity of enhanced regulations on IQOS' promotional content by limiting its overemphasis on "less odor" and "no ash", which may mislead consumers into perceiving it as clean and less harmful; and minimizing the graphic cues that send a strong hint of IQOS' resemblance to e-cigarettes (e.g., the sleek, discreet and high-tech appearance, the electronic charger, etc.). It also indicates a need to identify strategies that can pull people's attention away from the promotional content; at least, for young ever-vapers. In 2019, FDA issued a proposed rule to establish new pictorial warnings for cigarettes. Since the FDA's authorization of IQOS classified it as cigarettes in the US,<sup>10</sup> such pictorial warnings should also be required on HTPs' packaging and advertisements. Future research should examine the effects of large pictorial warnings on HTP attitudes and intentions.

Ever smoking status did not moderate the effects of visual attention, potentially echoing our discussion above, that the ad may have depicted a stronger visual resemblance between IQOS and e-cigarette, despite that its physical product features and potential harms are in reality, closer to those of cigarettes.<sup>43</sup> This may have lowered the perceived relevance and resonance with ever smokers, particularly the young adults in our sample who were mostly experimenting with smoking. It may be a fruitful avenue for future research to examine the visual attention patterns among established smokers.

Study limitations include use of a convenience sample of college-aged young adults; however, eye-tracking studies regularly employ convenience samples and our sample matched the target population of interest, and was comparable in size to other eye-tracking studies.<sup>15</sup> The study used a single ad, single exposure, and only one out of the three rotational SGWs for IQOS, which limited the generalizability of the findings. Considering that the specific SGW examined in this study focused on health consequences of smoking by pregnant women, it may be potentially less relevant to the young adult population. As a new tobacco product, the heavy streams of IQOS' advertising efforts have yet to come. However, it is worth noting that its first ad in the U.S. has shown consistency in the design style (e.g., sleek, clean, high-tech) and core product positioning (e.g., real tobacco, no ash, less odor), with that of the IQOS' marketing materials already advertised in other countries<sup>44</sup>. Thus, our examination of the first print ad of IQOS in the U.S. market may speak to future ads, which are likely to follow the same core marketing strategies and can provide timely insights regarding impacts and regulatory implications. We did not measure whether participants were exposed to IQOS in real life (e.g., by visiting IQOS) stores. Given that at the time of the study only few IQOS retail points were open in Atlanta, we anticipate only few participants could have had exposure and this would not

have changed the results in any substantive way. Nonetheless, future studies should assess exposure to the product in real life, particularly given the growing number of IQOS retail locations in the U.S. and the FDA's authorization of a modified exposure claim for IQOS.

In conclusion, this study provides important insights into how young adults, including those who have vaped, may interact with IQOS ads. It indicates that even if two warnings are present, promotional content can garner more attention and be more influential. Additional research using eye-tracking technology is needed to replicate and extend this finding, including to identify warning label characteristics that may be more influential, particularly when it comes to new tobacco products. Importantly, this study also reaffirms the need to assess IQOS advertising effects by sub-population, particularly those who have used e-cigarettes or cigarettes.

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*Table 1. Eye-Tracking Attention Measures in Predicting Masked Recall and Aided Recognition of the Warning AOIs*

	NW		SGW	
	Masked Recall	Aided Recognition	Masked Recall	Aided Recognition
Fixation Count	.15	-.04	.25**	.34***
Total Fixation Duration	.14	-.01	.28***	.35***
Time to First Fixation	.04	-.01	-.13	-.001

*Note:* Standardized regression coefficients are reported. All regressions controlled for demographic variables including age, sex, race and ethnicity. *NW*=mandated nicotine warning area; *SGW*=Surgeon General's warning area.

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

Table 2. Attention in Warning and Promotion AOIs Interacting with Vaper and Smoker Status on Attitude and Intention to Use IQOS, Controlling for Demographic Variables

IVs	DVs	Attitude			Intention		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
%Attention in Warning AOIs		.024 (.881)	-.007 (1.317)	.017 (.982)	-.016 (.625)	-.002 (.847)	.038 (.644)
%Attention in Promotion AOIs		.186 (.769)*	-.115 (1.204)	.108 (.870)	.082 (.545)	-.131 (.774)	.051 (.570)
Age		.101 (.042)	.118 (.041)	.068 (.041)	-.023 (.030)	-.017 (.026)	-.074 (.027)
Gender (ref. = Male)		-.096 (.137)	-.099 (.134)	-.062 (.135)	-.020 (.097)	-.018 (.086)	.034 (.089)
Hispanic (ref. = Non-Hispanic)		-.147 (.298)	-.126 (.294)	-.106 (.296)	-.174 (.211)	-.136 (.189)	-.100 (.194)
Race (ref. = White)							
	Black	-.168 (.228)*	-.160 (.224)*	-.163 (.223)*	-.171 (.161)*	-.147 (.144)*	-.159 (.146)*
	Asian and Pacific Islander	-.015 (.237)	.009 (.232)	-.005 (.232)	.118 (.168)	.158 (.149)*	.142 (.152)*
	Multiple races	.077 (.339)	.078 (.332)	.078 (.332)	.025 (.240)	.039 (.214)	.017 (.217)

IVs	DVs	Attitude			Intention		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Attention in Warning AOIs× Ever Vape Status		.118 (1.743)			-.011 (1.121)	
	Attention in Promotion AOIs ×Ever Vape Status		.825 (1.547)*			.393 (.995)	
	Attention in Warning AOIs× Ever Smoke Status			.096 (2.006)			-.240 (1.315)
	Attention in Promotion AOIs×Ever Smoke Status			.341 (1.721)			-.140 (1.128)

*Note.* Standardized regression coefficients  $\beta$  are reported in this table; standard errors associated with each of the point estimates are in parentheses. Models 1 and 4 present main effects models without the interaction terms. Models 2 and 5 present conditional main effects models where interaction between attention and ever vaper status is taken into consideration. Models 3 and 6 present conditional main effects models where interaction between attention and ever smoker status is taken into consideration. No multicollinearity was detected in the models (VIFs range from 1.02-1.55). \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

## FIGURE LEGENDS

### Figure 1: IQOS ad stimulus

[INSERT FIGURE 1 HERE]

(A) original IQOS ad used in the eye-tracking session; (B) IQOS ad with AOIs marked; (C) IQOS ad with areas masked for participant recall during post-exposure survey.

*Note:* AOI – area of interest; NW AOI – nicotine warning AOI (“*Warning: This product contains nicotine. Nicotine is an addictive chemical.*”); SGW AOI – Surgeon General’s Warning AOI (“*SURGEON GENERAL’S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.*”); PT AOI – promotional text AOI (“*Meet IQOS. REAL TOBACCO | NO ASH | LESS ODOR*”); PV AOI – promotional visual AOI.

*Note:* The brand name was intentionally blurred in this Figure to comply with journal policy.

### Figure 2: Moderated mediation model

[INSERT FIGURE 2 HERE]

*Note:* Standardized regression coefficients  $\beta$  are presented. Dotted line shows the direct effect of attention on intention when attitude is not included as a mediator. All regressions controlled for demographic variables. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

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### Contribution of Authors

JL, JP, DK, GN, and LP conceptualized the study. JL supervised the data collection, conducted the statistical analyses and wrote the first draft. LX trained research assistants and contributed to data collection, coding masked recall, and data analysis. All authors contributed to the writing and revision and approved the final version of the manuscript.

### Author Notes

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### Competing Interests

The authors have no conflict of interest.

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### Ethical Approval

The study was approved by the University of Georgia IRB.

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Figure 1



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Figure 2

