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Eye Movement Patterns in Response to Anti-Binge Drinking Messages

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Abstract

Health message design combines selected visual and textual components that are thought to work in concert to produce a particular intended message effect. Most health message effects research assumes rather than determines that message recipients attend to those visual and textual components. In contrast, the present research mapped viewing patterns of 50 participants in response to a set of anti-binge drinking print messages using eye-tracking methodology. Results showed that participants primarily viewed faces of persons portrayed in the messages, as well as alcohol use cues and cryptic one-liners. Textual components (e.g., information about consequences of heavy drinking) were viewed infrequently and briefly. Viewing patterns were associated with perceptions of message effectiveness, but more so for women than for men. Additionally, men, for whom anti-binge drinking messages were more self-relevant than for women, viewed message components more often and longer than women. These findings suggest that when message recipients view a self-relevant health message, they may attend primarily to a subset of components that do not necessarily convey the full message.

Heavy alcohol use among college students in the United States is prevalent (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014) and has serious individual, social, and economic consequences (Hingson et al., 2005; Miller et al., 2006). Message-based interventions that aim to change how college students feel, think, and act regarding heavy drinking are widely used to abate this public health problem (Finlay, Ram, Maggs, & Caldwell, 2012). There is evidence that message-based interventions can affect alcohol use. For example, Snyder and colleagues synthesized effects of anti-alcohol interventions on drinking behavior and found an average effect size of $r = .09$ (Snyder et al., 2004). Whether such effect sizes reflect the ceiling of message potential for curbing heavy drinking remains unclear, because how exactly people attend to anti-drinking messages is a question that is in need of better answers (Brown & Richardson, 2012). The present research focused on this

question. Specifically, we tested students' visual attention to components of anti-binge drinking messages that are thought to be crucial for persuasion.

Attentional Responses to Health Messages

A health message is the result of a creative yet principled process in which particular message features are combined based on the idea that collectively, these features are persuasive (Cappella, 2006). It stands to reason then, that if, for example, particular visuals were selected for health message design, all those visuals should be attended to for the message to produce its intended persuasive effect. This is not to say that all message components should necessarily receive the same amount of attention, as certain components may carry more persuasive weight than others, and similarly, the persuasive weight of certain message components may depend on the presence of other message components. For example, Kang, Cappella, and Fishbein (2006) found that among a sample of adolescents at risk for marijuana use, message sensation value negatively affected the persuasiveness of the strength of arguments used in anti-marijuana messages, conceivably because the relatively frequent use of "Don't" to start strong argument, high sensation value messages triggered a reactance response to these messages. Such findings underscore that a message's ultimate effects on outcomes such as attitude, intention, and behavior importantly depend on attention to specific message components. For a full understanding of message outcomes, it therefore is necessary to test attentional processes that occur upon message exposure (Stephenson, Southwell, & Yzer, 2011).

Most health message effects research does not focus on attentional processes upon immediate message exposure, however. Instead, it is more common to test direct message effects on distal outcomes, for example by comparing study participants who were or were not exposed to a message on attitude and intention regarding a particular health behavior. Such message effects work on distal outcomes has important strengths. For example, it helps identify which messages are associated with attitude change and which are not. However, if a particular message has no demonstrable effects on attitude, then a singular focus on attitude (or any other distal outcome) cannot answer the question why the message was not effective: Did the message lack critical design components, or were necessary components in place but not attended to? An answer to this question would considerably advance understanding of health message effects.

Research on defensive responses to evocative, self-relevant health messages supports the importance of understanding what exactly people attend to in a health message. As a general rule, evocative cues (such as vivid portrayals of negative consequences) and self-relevance cues (such as age, gender and other similarity markers) draw attention, and attention triggers cognitive and behavioral responses (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Importantly, however, in a health context, messages often imply the possibility of negative health consequences for the message recipient, which can produce aversive emotional states (Yzer, Southwell, & Stephenson, 2013). An effective way of coping with such aversive states is to selectively attend to non-threatening message components and not attend to threatening message components, if not avoiding the message altogether (Strasser, Tang, Romer, Jepson, & Cappella, 2012). For example, Kessels, Ruiter, and Jansma (2010)

measured event-related potentials in response to high and low risk smoking images, and they found that smokers, for whom the images were relevant, responded less to high risk than low risk images (indicated by lower P300 amplitudes). Brown and Richardson (2012) measured eye movement in response to anti-alcohol messages, and they found that alcohol users' gaze time to text in distressing anti-alcohol messages was shorter than gaze time to text in non-distressing anti-alcohol messages. Both these examples indicate attentional disengagement with personally relevant health messages. They also support the general principle that attentional processes occur automatically upon exposure, which underscores the need for research on attentional processes in response to health messages.

The Present Research

The broad goal of the present research was to map visual attention to key visual and textual message components of a set of print messages that previously had been used to discourage binge drinking among college students at a large public university in the United States. We took an eye-tracking approach for this purpose. Eye-tracking methodology can directly measure eye movement patterns, such as how often (e.g., fixations), how long (e.g., dwell time), and when (e.g., time to first fixation) particular message components are viewed. Eye movement has been shown to reflect visual attention and cognitive processing (Rayner, 1998; Strasser et al., 2012).

We had two specific objectives. Our first objective was to test gender differences in visual attention to anti-binge drinking messages. We used gender as a proxy of the relevance of anti-binge drinking messages, because anti-drinking messages often are gender-specific in design. The set of messages used in the present research offers a pertinent example: Of the five messages we used, two featured men in a prominent role, two featured women, and one featured both a man and a woman. Moreover, well-documented gender differences in alcohol use among U.S. college students suggest that messages about heavy drinking are differentially relevant for men and women, because male college students drink more than female college students and are more likely to engage in heavy drinking (White et al., 2006). For example, recent data from a nationally representative sample showed that 43% of male college students and 30% of female college students reported having had more than five drinks on one occasion in the two weeks before the study (Johnston et al., 2014).

We based our gender effect expectations on two contentions. First, self-relevance of a message increases attention to a message (Baumeister et al., 2001). Second, if a self-relevant message has threatening components, attention to those message components is reduced (e.g., Brown & Richardson, 2012; Yzer, Southwell, & Stephenson, 2013). Thus, we posed the following hypothesis: Men will attend longer (i.e., longer viewing time and dwell time) and sooner (i.e., shorter time to first fixation) to drinking-related content than women but attend not as long and later to anti-drinking content (Hypothesis 1).

Our second objective was to test the implications of visual attention for perceptions of message effectiveness. Perceived message effectiveness has been conceptualized as appraisals following immediate exposure to messages (Yzer, LoRusso, & Nagler, 2015) and has been tested as outcomes in research on attention to health messages (e.g., Kang,

Cappella, & Fishbein, 2006). In further support of the appropriateness of testing the association between visual attention to anti-binge drinking messages and perceptions of those messages' effectiveness, research has found that perceptions of message effectiveness correlate with markers of actual effectiveness, such as attitude and intention (e.g., Davis et al., 2017). Consistent with our self-relevance explanation for gender effects on eye movement, we hypothesized the following: Men will perceive anti-binge drinking messages as less effective than women (Hypothesis 2).

To the best of our knowledge, prior research has not examined whether visual attention to a message shapes its perceived effectiveness. We therefore articulated two research questions (RQ): One, does visual attention to anti-binge drinking messages correlate with perceived message effectiveness ratings? And two, are correlations between visual attention to anti-binge drinking messages and perceived message effectiveness different for men and women?

Method

Participants

We recruited 50 undergraduate college students from the University of Minnesota. Our sample was balanced on gender by design. We recruited 25 female and 25 male participants. Mean age was 20 years, $SD = 1.80$. All but two participants had lifetime experience with alcohol (assessed with the yes-no question, "Have you ever, even once, had a drink of any alcoholic beverage, that is, more than a few sips?"). In the present research we assessed frequency of heavy drinking by asking, "Think back over the last 30 days. How many times have you had four or more drinks in a row? By a 'drink' we mean a can or bottle of beer, a glass of wine or a wine cooler, a shot of liquor, or a mixed drink with liquor in it?" (1 = never, 2 = once, 3 = twice, 4 = 3 to 5 times, 5 = 6 to 9 times, and 6 = 10 or more times). Thirty-eight participants (76%) had engaged in heavy drinking on at least one occasion in the 30 days preceding the study, of whom 17 were women and 21 were men. Men reported a greater number of heavy drinking occasions ($M = 3.48$) than women ($M = 2.56$), $F(1, 48) = 5.27$, $p = .026$, partial $\eta^2 = .10$.

Stimulus Materials

The stimuli were five messages that had been part of an anti-binge drinking campaign that targeted students from the same university as where we conducted our study. The campaign ran between September and December 2010 on the university's campus. Our study was conducted three years after the end of the campaign. Thus, none of our participants were directly exposed to campaign activity during the three years prior to our study.

Each of the five messages portrayed a situation in which an inebriated young adult engages in "regrettable" behavior: a young man making inappropriate advances toward a young woman (*Creep*), a young man and a young woman kissing passionately (*Make-out*), a young woman lying on the floor of a room crying (*Crier*), a young woman taking her shirt off (*Flasher*), and two young men in a violent argument (*Fighter*). Each message portrayed the drunk person around other people who look at the drinker in disapproval. Alcohol cues, such as half-empty pitchers and knocked-over bottles, suggested that large amounts of alcohol

had been consumed. The campaign logo, placed in the bottom right corner, was the text “The Other Hangover” printed in a water ring left by a glass. Next to the logo one of four negative affective consequences of heavy drinking was printed (regret, humiliation, embarrassment, or shame). The behavioral cue “Don't overdo it” was placed in the bottom left corner. The logo and behavioral cue were the same in the five messages. The one-liners were unique to each ad and contextualized the visual: “Before you got wasted, you weren't known as the Creep” (*Creep*); “even though you were drunk, this still happened” (*Make-out*); “a few drinks before, they thought you were fabulous” (*Crier*); “reputations aren't drunk-proof” (*Flasher*); and “friendships aren't drunk-proof” (*Fighter*). The drinker, alcohol cues, and the word “Other” in the logo were in color. All other message components were in black and white. Figure 1 displays the messages.

Procedures

Participants came to our lab for an assigned session. After consenting to study participation, they were introduced to the eye-tracking equipment. The eye-tracking sensor was placed below a flat panel screen. Participants engaged in a trial task to calibrate the eye-tracking sensor to pupil focus and movement. Each participant was next asked to view all five messages and to take as much time as they liked. To proceed participants clicked a button when they felt they had seen a particular message long enough. On average, participants viewed each message 14.08 seconds. The five messages did not differ in how long each message was viewed, $F(4, 196) = 1.387, p = .240$, partial $\eta^2 = .03$. Message order was randomized. After each message, participants responded to perceived message effectiveness questions. The study took about 30 minutes on average to complete. After debriefing, participants were reimbursed with \$20.

Eye-tracking

Equipment—We used the Tobii X60 eye-tracker to record eye movement, which has a 0.5° average gaze position accuracy. The tracker was placed below a 21-inch flat panel screen at a distance of 27 inches to participants' eyes.

Areas of interest and eye movement measures—For each message, we coded seven areas of interest: Drinkers (visual), bystanders (visual), alcohol cues (visual), one-liners (text), logo (text), emotion (text), and the behavioral cue (text). Of these, drinkers and alcohol cues are most clearly drinking-related content, whereas one-liners, logo, emotion, and behavioral cues are most clearly anti-drinking content. For each area we measured the number of fixations, milliseconds of dwell time, and milliseconds to first fixation. (Whereas we measured time-sensitive variables in milliseconds, we report findings in seconds.) A fixation is a gaze, or simply put, a period of no eye movement that exceeds a predetermined velocity (i.e., pixel by milliseconds) threshold. Dwell time is the total amount of time a particular area was viewed, which is the sum of the duration of all fixations on any point in an area of interest and saccades, or “travel time,” that is eye movement between two fixations. Some message components were included multiple times within a message but placed at different locations. For example, bystanders were placed on both sides of a drinker. Because we were interested in the type of message component rather than individual locations, we summed viewing data for each of these locations to create single quantitative

viewing indicators for each component of interest. Last, we recorded the total viewing time for each message.

Self-reported measures

Perceived message effectiveness—Participants rated each message on six 7-point items, which were presented in random order. Based on previous research (Yzer, Vohs, Luciana, Cuthbert, & MacDonald, 2011), these items were used to form, for each message, a four-item perceived convincingness scale and a two-item perceived pleasantness scale. The phrase “To me, this ad was ...:” was followed by semantic differential scales with the anchors *extremely unconvincing*—*extremely convincing*, *extremely unbelievable*—*extremely believable*, *extremely forgettable*—*extremely memorable*, *extremely bad*—*extremely good* (perceived convincingness), and *extremely unpleasant*—*extremely pleasant* and *extremely negative*—*extremely positive* (perceived pleasantness). We computed convincingness and pleasantness scales across the five messages by averaging the convincingness items (Cronbach's alpha = .86) and averaging the pleasantness items (Cronbach's alpha = .76).

Results

Preliminary Analyses: Collapsing Data across Messages

We hypothesized that men would spend more time with drinking-related message components and less time with patent anti-drinking message components than women. If true, then gender differences in visual attention should be consistent across messages. Alternatively, gender differences in visual attention might be a function of the gender of the person most prominently featured in a message. In that case, men might attend more closely to messages that featured men (i.e., *Creep* and *Fighter*), women might attend more closely to messages that featured women (i.e., *Crier* and *Flasher*) and men and women should pay equal attention to messages that featured both men and women in the roles of inebriated persons (i.e., *Make-out*).

If the alternative hypothesis is true, then we should report gender effects on eye movement for each separate message. If not, then we can test gender effects on eye movement across the five messages. To inform this decision we used multivariate GLM analyses to test gender effects on eye movement in each message and then inspected whether these gender effects differed between messages. Three types of eye movement data (fixation count, dwell time, and time to first fixation) were available for each of the seven areas of interest. We built separate GLM models for the three types of eye movement variables. Total viewing time was included in the dwell time GLM model. Thus, for each of the five messages we compared male and female participants on 22 eye movement variables. We tested whether gender differences in eye movement variables varied by message in terms of magnitude and directionality. Directionality of gender differences has to do with the question whether men attend longer, more often, or sooner than women, or women attend longer, more often, or sooner than men.

These analyses determined that gender differences in eye movement were remarkably similar across the five messages: In 22 strings of five gender comparison sets (representing 110 gender differences), only four differences in directionality were found. Compared to men, women took a longer time to first fixation on alcohol cues in *Flasher*, on bystanders for *Flasher*, on the behavioral cue in *Fighter*, and on the emotion in *Make-out*, whereas men took a longer time to first fixation on these particular areas of interest in the other four messages. All other gender differences were similar in directionality and magnitude across messages. We therefore collapsed data across the five messages and will report gender differences in total viewing time, as well as fixation count, dwell time, and time to first fixation for each of the seven areas of interest across all messages.

Hypothesis 1: Gender Differences in Eye Movement

Time to first fixation (TFF)—The time elapsed before fixation on particular areas provides information on the sequence of attention allocation to particular message components. Our participants viewed the one-liner first (using TFF averages per message, $TFF_{\text{women}} = 0.97$ seconds and $TFF_{\text{men}} = 1.16$ s), quickly followed by drinkers ($TFF_{\text{women}} = 2.37$ s and $TFF_{\text{men}} = 2.17$ s) and then the other visual message components; bystanders ($TFF_{\text{women}} = 5.16$ s and $TFF_{\text{men}} = 4.63$ s), and alcohol cues ($TFF_{\text{women}} = 6.85$ s and $TFF_{\text{men}} = 5.18$ s; $p = .058$, partial $\eta^2 = .09$). The components that took the longest to receive a first visit were all textual; the behavioral cue ($TFF_{\text{women}} = 7.50$ s and $TFF_{\text{men}} = 7.68$ s), the emotion ($TFF_{\text{women}} = 8.18$ s and $TFF_{\text{men}} = 8.80$ s), and the logo ($TFF_{\text{women}} = 8.79$ s and $TFF_{\text{men}} = 11.97$ s). In contrast to Hypothesis 1, gender was not associated with TFF in a statistically and practically meaningful way: First, none of the gender differences in TFF were statistically significant at levels below $p = .058$, and second, the sequence of attention allocation was identical for women and men.

Number of fixations—Whereas the TFF results showed no substantive gender effects on the order in which message components were viewed, Hypothesis 1 was supported for the number of fixations on message components. The total number of fixations across messages and areas of interest was $n = 115.92$ for women and $n = 173.00$ for men, $F(1, 48) = 7.64$, $p = .008$, partial $\eta^2 = .14$. This pattern of more fixations for men than women was observed for each of the seven areas of interest (see Table 1). From a statistical perspective, the most meaningful gender differences regarded more fixations for men than women on drinkers, mean difference = 13.52, $F(1, 48) = 5.19$, $p = .027$, partial $\eta^2 = .10$; bystanders, mean difference = 10.36, $F(1, 48) = 8.20$, $p = .006$, partial $\eta^2 = .15$; alcohol cues, mean difference = 8.68, $F(1, 48) = 7.22$, $p = .010$, partial $\eta^2 = .13$; one-liner, mean difference = 14.36, $F(1, 48) = 5.03$, $p = .030$, partial $\eta^2 = .10$; and emotion, mean difference = 3.12, $F(1, 48) = 5.68$, $p = .021$, partial $\eta^2 = .11$.

Total viewing and dwell time—Hypothesis 1 also found support across our analyses of viewing time. To begin, the mean total time spent viewing the five messages was 60.60 seconds for women and 76.85 seconds for men, $F(1, 48) = 2.81$, $p = .100$, partial $\eta^2 = .06$. Women and men similarly differed in the total time they spent viewing message components. This effect had a more compelling effect size: Mean total dwell time across areas of interest was 29.16 seconds for women and 46.75 seconds for men, $F(1, 48) = 8.13$, $p = .007$, partial $\eta^2 = .14$.

= .006, partial $\eta^2 = .15$. (Total viewing time is greater than total dwell time, because total viewing time included the entire visual but dwell time only areas of interest.) This pattern of longer dwell time for men than for women was observed for each of the seven areas of interest (Table 1). Similar to fixation counts findings, the most meaningful gender differences regarded longer dwell time for men than women regarding drinkers, mean difference = 4.85s, $F(1, 48) = 5.13$, $p = .028$, partial $\eta^2 = .10$; bystanders, mean difference = 4.46s, $F(1, 48) = 1135$, $p = .001$, partial $\eta^2 = .19$; alcohol cues, mean difference = 2.62s, $F(1, 48) = 8.00$, $p = .007$, partial $\eta^2 = .14$; one-liner, mean difference = 2.99s, $F(1, 48) = 2.92$, $p = .094$, partial $\eta^2 = .06$; and emotion, mean difference = 1.07s, $F(1, 48) = 6.94$, $p = .011$, partial $\eta^2 = .13$.

Hypothesis 2: Gender Effects on Perceived Message Effectiveness

The convincingness and the pleasantness scales correlated moderately, $r = .34$. To test gender differences in perceived convincingness and pleasantness we ran a multivariate GLM, which showed a multivariate gender effect $F(2, 47) = 3.55$, $p = .037$, partial $\eta^2 = .13$. In contrast to Hypothesis 2, the GLM analysis showed univariate gender effects on perceived pleasantness, $F(1, 48) = 4.50$, $p = .039$, partial $\eta^2 = .09$, $M_{\text{women}} = 3.04$, $SD = .47$, and $M_{\text{men}} = 3.41$, $SD = .73$, but not on perceived convincingness, $F(1, 48) = 0.51$, $p = .479$, partial $\eta^2 = .01$, $M_{\text{women}} = 4.79$, $SD = .62$, and $M_{\text{men}} = 4.64$, $SD = .88$. A repeated measures GLM showed that the convincingness-pleasantness differences varied by gender at a statistically significant level, $F(1, 48) = 5.71$, $p = .021$, partial $\eta^2 = .11$. These findings suggest that both men and women found the messages more convincing than pleasant, but the difference between convincingness and pleasantness was smaller for men. Note that in absolute terms, convincingness scores were just somewhat beyond the midpoint for both men and women.

RQ 1: Eye Movement—Perceived Message Effectiveness Associations

Table 2 has correlations between eye movement variables (fixation count, total viewing time, and dwell time) and perceived convincingness and pleasantness. The “overall” columns in Table 2, which report findings across gender, show that messages were perceived as more convincing when fixations on drinkers, the behavioral cue, and the logo increased; when more time was spent viewing the messages; and particularly when more time was spent dwelling on the logo and the behavioral cue. Messages were perceived as more pleasant when fixations on the behavioral cue, the logo, and the one-liner increased; when more time was spent viewing the messages; and particularly when more time was spent dwelling on the logo, the emotion text, and the behavioral cue. These findings support the possibility that viewing patterns, i.e., fixations and viewing time, are associated with effectiveness ratings of a message.

RQ 2: Gender Effects on Eye Movement–Perceived Message Effectiveness Associations

We next tested whether the extent to which eye movement affected perceived message effectiveness was different for men and women. Our sample was too small to allow regression analyses that include gender as a moderator. Instead we chose a less conclusive but, given our sample size, appropriate approach: We compared men and women on bivariate correlations between eye movement variables and perceived convincingness and pleasantness.

Table 2 shows that the more fixations women had on drinkers, alcohol cues, logos, emotion, and behavioral cues, the more convincing they perceived messages to be. The more fixations men had on drinkers, logos, and behavioral cues, the more convincing they perceived messages to be. For both women and men fixations on behavioral cues contributed to perceived message pleasantness, and for men, so did fixations on one-liners and logos.

Gender differences were also observed for dwell time. The total time that messages were viewed was strongly associated with perceived convincingness ($r = .57$) and with perceived pleasantness ($r = .52$) for women, but less so for men ($r = .30$ and $r = .37$). These findings were similar for total dwell time across areas of interest: $r = .48$ and $r = .52$ for total dwell time associations with perceived convincingness and pleasantness for women, and $r = .32$ and $r = .30$ for men. Furthermore, for women, dwell time on drinkers, logo, and emotion was associated with perceived convincingness, whereas for men, dwell time on behavioral cues in particular was associated with perceived convincingness. For women, dwell time on drinkers, logo, and behavioral cues was associated with perceived pleasantness, whereas for men, dwell time on one-liners, logo, and behavioral cues was associated with perceived pleasantness. These findings suggest the important idea that we cannot assume that viewing patterns shape message effectiveness perceptions in a universal way.

Ancillary Analysis: Interpreting Viewing Patterns through Heat Maps

To aid the interpretation of the quantitative eye movement findings, we additionally inspected heat maps for a qualitative assessment of viewing patterns. Heat maps are visual aids that superimpose color codes onto the viewed visual to indicate the accumulated number of fixations or dwell time from all participants. Here we report heat maps of accumulated fixation counts (see Figure 1). Color values range from light green (weak viewing) to yellow (moderate viewing) to red (heavy viewing) and no colors indicate saccades. Recall that analyses of the eye movement variables indicated that the one-liners, drinkers, and bystanders areas of interest were most heavily viewed. The heat maps make strikingly clear that within these patterns, participants principally focused their attention on faces. In fact, an ancillary analysis in which we defined faces of drinkers and bystanders as a single area of interest showed that although faces occupied a very small part of the total areas of interest, 23% of fixations were on faces and 30% of dwell time was on faces.

Discussion

In this study we examined attention allocation to specific components of anti-binge drinking messages. The persuasive components of the messages that we submitted to eye movement analysis included visual portrayals of drinkers, bystanders, and alcohol use cues, as well as textual information about behavioral cues and affective consequences of binge drinking in one-liners and logos. Although all these message components were viewed, attention allocation to individual components varied considerably. Simply put, our participants primarily viewed one-liners and faces of drinkers and bystanders. These were among the first message components to be viewed and were also viewed with the highest frequency and longest duration. Except for the prominently positioned one-liners, textual information was viewed infrequently and briefly. This is important, because processing visuals requires much

less cognitive effort—and thus fixation time—than text (Rayner et al., 2001; Thomsen & Fulton, 2007), and extracting information from a stimulus occurs during fixation (Rayner, 1998). Thus, because in the present research visuals received much more fixation time than text, it can be argued that visuals had considerably more persuasive potential than textual components.

We hypothesized and found gender differences in viewing patterns. Although men and women viewed the same message components, men, for whom binge drinking was argued to be more self-relevant than for women, viewed messages longer than women, and similarly, men viewed drinkers, bystanders, and one-liners more often and longer than women. This supports the contention that a message's self-relevance increases attention allocation to that message. It also suggests that men did not feel particularly threatened by the messages as a whole, as threatening self-relevant health messages lead to reduced attention allocation to the entire message or particular message components that are perceived as threatening (Kessels & Ruiter, 2012). The finding that men found the messages more pleasant than women supports this notion, because the perceived pleasantness of health messages has been found to be negatively associated with perceived threat (Yzer et al., 2011). Further work that compares messages that differ in perceived threat is necessary to corroborate this contention. Building on the present findings, we speculate that increased self-relevance of a health message leads to longer viewing of non-threatening health messages and shorter viewing of threatening messages and that with decreased self-relevance threatening message features do not affect viewing time.

Although men visually engaged more often and longer with the messages than women, correlational patterns suggest that eye movement might have been a source of evaluations of message convincingness and pleasantness more so for women than for men. The empirical literature does not offer a clear explanation for this difference. For example, Brown and Richardson (2012) examined message effectiveness perceptions in the context of eye movement in response to alcohol messages. Whereas they found that eye movement was related to alcohol use intentions, they did not test eye movement effects on message evaluations, nor did their work focus on gender differences in eye movement and message effectiveness perceptions. There is some evidence, however, that the more motivationally relevant a message, the less reliable perceived message effectiveness ratings become (Yzer, LoRusso, & Nagler, 2015). This would mean that in our sample, perceived effectiveness ratings were more variant for men than for women. Consistent with this, standard deviations for perceived convincingness and pleasantness were larger for men than women in our sample. This may mean that our measures more reliably measured perceived effectiveness for women than for men, which offers an explanation for weaker eye movement-effectiveness correlations.

Two instances in which gender did not affect viewing patterns merit further discussion. First, although the five messages we tested in this study differed in which gender they most prominently targeted, male and female participants did not attend differently to these messages as indicated by fixations and dwell time across messages. Second, male and female participants did not differ in the sequence of viewing message components. These two findings are consistent with brain imaging and psychophysiological research on gender

differences in attention to affective visual stimuli. Although men respond more strongly to pleasant visuals and women more strongly to negative visuals, men and women similarly attend more to motivationally relevant (mostly studied as arousing unpleasant and pleasant images) than neutral visuals (non-arousing images; Sabatinelli, Flaisch, Bradley, Fitzsimmons, & Lang, 2004; Wrase et al., 2003). This points at the possibility that whereas anti-drinking messages resonated differently for men and women (resulting in longer dwell time and more fixations for men), these messages were sufficiently relevant for both men and women to trigger a basic attentional process (manifested in similar attention allocation sequences as well as dwell time and fixation differences that were the same across messages).

The finding that faces were viewed relatively often and long suggests that faces held informative value. This is consistent with perception research that has shown that in a visual search task faces “pop out” compared to non-facial stimuli (e.g., Frischen, Smilek, Eastwood, & Tipper, 2007; Hershler & Hochstein, 2005). The role of facial information in health messages has not been systematically examined in health communication scholarship, although some researchers have begun to investigate the notion that faces matter distinctly as elements in ads (Lang, Bradley, Park, Shin, & Chung, 2006; Southwell, 2005). Our research was not designed to test effects of facial information, and we thus cannot speak to the question of how the presence or absence of faces in visual health messages affects attentional processes and cognitive responses. It is an intriguing question that offers a wealth of opportunities for research on visual attention to health messages.

Before concluding with a presentation of our primary results, we must caution that our results may not represent how people view anti-drinking messages in natural settings. As is true for all eye-tracking studies, in our study, participants were asked to view messages. Even though they were free to view each message for as long as they liked, we cannot be certain that these same participants would have spent as much time with these messages if they would have encountered them outside our lab. With this cautionary note in mind, we conclude with a number of results that are important for health communication scholarship. First, a subset of message components (faces and one-liners) were viewed much more often and longer than text that arguably included information necessary for full understanding of the intended message. This makes clear that in health message effects we should determine rather than assume that message components considered crucial for persuasion are in fact attended to. Second, the finding that men, for whom anti-binge drinking messages were arguably relevant, visually engaged with anti-binge drinking messages suggests that design features that are non-threatening can increase attention allocation to self-relevant health messages. Third, viewing patterns were associated more strongly with perceptions of message effectiveness for women than for men, which, if replicated, means that whereas viewing a message appears to inform message effectiveness perceptions, we cannot assume that viewing a message will do so in a universal manner.

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References

- Baumeister RF, Bratslavsky E, Finkenauer C, Vohs KD. Bad is stronger than good. *Review of General Psychology*. 2001; 5:323–370. DOI: 10.1037/1089-2680.5.4.323
- Brown SL, Richardson M. The effect of distressing imagery on attention to and persuasiveness of an antialcohol message: A gaze-tracking approach. *Health Education & Behavior*. 2012; 39:8–17. DOI: 10.1177/1090198111404411 [PubMed: 21632438]
- Cappella JN. Integrating message effects and behavior change theories: Organizing comments and unanswered questions. *Journal of Communication*. 2006; 56:S265–279. DOI: 10.1111/j.1460-2466.2006.00293.x
- Davis KC, Duke J, Shafer P, Patel D, Rodes R, Beistle D. Perceived effectiveness of antismoking ads and association with quit attempts among smokers: Evidence from the tips from former smokers campaign. *Health Communication*. 2017; 32:931–938. DOI: 10.1080/10410236.2016.1196413 [PubMed: 27435919]
- Finlay AK, Ram N, Maggs JL, Caldwell LL. Leisure activities, the social weekend, and alcohol use: Evidence from a daily study of first-year college students. *Journal of Studies on Alcohol and Drugs*. 2012; 73:250–259. [PubMed: 22333332]
- Frischen A, Smilek D, Eastwood JD, Tipper SP. Inhibition of return in response to gaze cues: The roles of time course and fixation cue. *Visual Cognition*. 2007; 15:881–895. DOI: 10.1080/13506280601112493
- Hershler O, Hochstein S. At first sight: A high-level pop out for faces. *Vision Research*. 2005; 45:1707–1724. DOI: 10.1016/j.visres.2004.12.021 [PubMed: 15792845]
- Hingson RW, Zha W, Weitzman ER. Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18–24, 1998–2005. *Journal of Studies on Alcohol and Drugs*. 2009; 16:12–20.
- Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE, Miech RA. Monitoring the Future national survey results on drug use, 1975–2013: Volume II, college students and adults ages 19–55. Ann Arbor: Institute for Social Research, The University of Michigan; 2014.
- Kang Y, Cappella J, Fishbein M. The attentional mechanism of message sensation value: Interaction between message sensation value and argument quality on message effectiveness. *Communication Monographs*. 2006; 73:351–378. DOI: 10.1080/03637750601024164
- Kessels LTE, Ruiter RAC. Eye movement responses to health messages on cigarette packages. *BMC Public Health*. 2012; 12:1–9. DOI: 10.1186/1471-2458-12-352 [PubMed: 22214479]
- Kessels LTE, Ruiter RAC, Jansma BM. Increased attention but more efficient disengagement: Neuroscientific evidence for defensive processing of threatening health information. *Health Psychology*. 2010; 29:346–354. DOI: 10.1037/a0019372 [PubMed: 20658820]
- Lang A, Bradley SD, Park B, Shin M, Chung Y. Parsing the resource pie: Using STRTs to measure attention to mediated messages. *Media Psychology*. 2006; 8:369–394. DOI: 10.1207/s1532785xmep0804_3
- Miller T, Snowden C, Birckmayer J, Hendrie D. Retail alcohol monopolies, underage drinking, and youth impaired driving deaths. *Accident Analysis and Prevention*. 2006; 38:1162–1167. DOI: 10.1016/j.aap.2006.05.003 [PubMed: 16787633]
- Rayner K. Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*. 1998; 124:372–422. DOI: 10.1037/0033-2909.124.3.372 [PubMed: 9849112]
- Rayner K, Rotello CM, Stewart AJ, Keir J, Duffy SA. Integrating text and pictorial information: Eye movements when looking at print advertisements. *Journal of Experimental Psychology*. 2001; 7:219–226. DOI: 10.1037/1076-898X.7.3.219 [PubMed: 11676100]
- Sabatinielli D, Flaisch T, Bradley MM, Fitzsimmons JR, Lang PJ. Affective picture perception: Gender differences in visual cortex? *Neuroreport*. 2004; 15:1109–1112. DOI: 10.1097/00001756-200405190-00005 [PubMed: 15129155]

- Snyder LB, Hamilton MA, Mitchell EW, Kiwanuka-Tondo J, Fleming-Milici F, Proctor D. A meta-analysis of the effect of mediated health communication campaigns on behavior change in the United States. *Journal of Health Communication*. 2004; 9:71–96. DOI: 10.1080/10810730490271548 [PubMed: 14960405]
- Southwell BG. Between messages and people: A multilevel model of memory for television content. *Communication Research*. 2005; 32:112–140. DOI: 10.1177/0093650204271401
- Stephenson MT, Southwell BG, Yzer MC. Advancing health communication research to the next level: Issues and controversies in experimental design and data analysis. In: Thompson TL, Parrott RL, Nussbaum J, editors *Routledge handbook of health communication*. New York: Routledge; 2011. 560–577.
- Strasser AA, Tang KZ, Romer D, Jepson C, Cappella JN. Graphic warning labels in cigarette advertisements: Recall and viewing patterns. *American Journal of Preventive Medicine*. 2012; 43:41–47. DOI: 10.1016/j.amepre.2012.02.026 [PubMed: 22704744]
- Thomsen SR, Fulton K. Adolescents' attention to responsibility messages in magazine alcohol advertisements: An eye-tracking approach. *Journal of Adolescent Health*. 2007; 41:27–34. DOI: 10.1016/j.jadohealth.2007.02.014 [PubMed: 17577531]
- White AM, Kraus CL, Swartzwelder H. Many college freshmen drink at levels far beyond the binge threshold. *Alcoholism: Clinical and Experimental Research*. 2006; 30:1006–1010. DOI: 10.1111/j.1530-0277.2006.00122.x
- Wrase J, Klein S, Gruesser SM, Hermann D, Flor H, Mann K, Heinz A. Gender differences in the processing of standardized emotional visual stimuli in humans: A functional magnetic resonance imaging study. *Neuroscience Letters*. 2003; 348:41–45. [PubMed: 12893421]
- Yzer M, LoRusso S, Nagler RH. On the conceptual ambiguity surrounding perceived message effectiveness. *Health Communication*. 2015; 30:125–134. DOI: 10.1080/10410236.2014.974131 [PubMed: 25470437]
- Yzer MC, Southwell BG, Stephenson MT. Inducing fear as a public communication campaign strategy. In: Rice RE, Atkin CK, editors *Public communication campaigns*. 4th. Thousand Oaks, CA: Sage; 2013. 163–176.
- Yzer MC, Vohs KD, Luciana M, Cuthbert BN, MacDonald AW. Affective antecedents of the perceived effectiveness of antidrug advertisements: An analysis of adolescents' momentary and retrospective evaluations. *Prevention Science*. 2011; 12:278–288. DOI: 10.1007/s11121-011-0212-y [PubMed: 21499729]

Figure 1. Stimulus materials and heat map results (i.e., accumulated fixation counts). From top to bottom, messages labeled “the Creep”, “Make-out”, “the Crier”, “the Flasher”, and “the Fighter.”

Table 1
Eye Movement by Gender for Areas of Interest across Five Messages: Gaze Data

Measure	Area of interest	Means for Gender Groups	
		Women	Men
Fixation count	Drinkers	32.08 *	45.60 *
	Bystanders	18.00 **	28.36 **
	Alcohol cues	12.00 **	20.68 **
	One-liner	34.76 *	49.12 *
	Logo	6.44	8.48
	Emotion	3.52 *	6.64 *
	Behavioral cue	9.12	14.12
Total viewing time in seconds	Entire message	60.60 [#]	76.58 [#]
Dwell time in seconds	Across all areas	29.16 **	46.75 **
	Drinkers	8.71 *	13.56 *
	Bystanders	4.33 ***	8.79 ***
	Alcohol cues	2.83 **	5.45 **
	One-liner	8.93 [#]	11.92 [#]
	Logo	1.42	1.74
	Emotion	0.84 *	1.91 *
	Behavioral cue	2.12	3.38

Note.

[#] $p < .10$;

* $p < .05$;

** $p < .01$;

*** $p < .001$.

Table 2
Correlations between Eye Movement Variables and Perceived Convincingness and Perceived Pleasantness overall and by Gender across Five Messages

Measure	Area of Interest	Perceived convincingness			Perceived pleasantness		
		Overall	Women	Men	Overall	Women	Men
Fixation count	Drinkers	.37**	.46*	.40*	.31*	.33	.20
	Bystanders	.21	.10	.37#	.31*	.08	.29
	Alcohol cues	.22	.43*	.19	.11	.25	-.12
	One-liner	.22	.27	.26	.53***	.30	.57**
	Logo	.44**	.46*	.49*	.50***	.39#	.59**
Emotion	Emotion	.35*	.45*	.38#	.31*	.10	.31
	Behavioral cue	.42**	.42*	.48*	.48***	.45*	.44*
	Entire message	.37**	.57**	.30	.46***	.52**	.37#
Total viewing time in seconds							
Dwell time in seconds	Across all areas	.30*	.48*	.32	.44***	.52**	.30
	Drinkers	.29*	.51**	.25	.27#	.52**	.05
	Bystanders	.15	.19	.24	.25#	.13	.13
	Alcohol cues	.12	.38#	.07	.13	.38#	-.13
	One-liner	.18	.21	.21	.56***	.37#	.59**
Logo	Logo	.39**	.48*	.38#	.48***	.45*	.54**
	Emotion	.34*	.51**	.37#	.41**	.29	.36#
	Behavioral cue	.40**	.35#	.50*	.52***	.50*	.51**

Note.

$p < .10$;

* $p < .05$;

** $p < .01$;

*** $p < .001$.